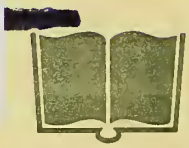
DOCUMENTS DEPARTMENT

5/S



SAN FRANCISCO
PUBLIC LIBRARY

DOCUMENTS DEPT.

REFERENCE BOOK

Not to be taken from the Library

AUG 17 1972

SAN FRANCISCO PUBLIC LIBRARY
3 1223 90012 7490

SAN FRANCISCO MASTER PLAN FOR WASTE WATER MANAGEMENT

S. F.

DOCUMENTS

SEP 22 1971

SAN FRANCISCO

PRELIMINARY SUMMARY REPORT

PREPARED BY
DEPARTMENT OF PUBLIC WORKS

SEPT. 15, 1971

SAN FRANCISCO MASTER PLAN FOR WASTE WATER MANAGEMENT

PRELIMINARY SUMMARY REPORT

PREPARED BY
DEPARTMENT OF PUBLIC WORKS
SEPT. 15, 1971

SAN FRANCISCO
PUBLIC LIBRARY

*628.16
Sa52m
v.1

72-54

ABSTRACT

Problem

The three problems that the City has relative to waste water management are:

(a) 50% of the public sewers are undersized to transport the design storm runoff.

(b) The effluents from the City's three treatment plants do not now meet existing water quality requirements. The $65 million 1970 water pollution control bond issue, provided $35 million for dry weather treatment improvements. These funds, together with anticipated federal and state grants, provide the necessary means to complete a program by July 1973 to meet the quality requirements existing in 1969. New requirements subsequently passed, or now being contemplated by the regulatory agencies will necessitate a much higher degree of treatment than that presently financed.

(c) Overflows presently discharge from the 42 combined sewer outfalls in the City on an average of 82 times per year. This wet weather problem has been defined by the recent requirements adopted by the Regional Board. The means of treating and controlling this overflow, which is a mixture of sanitary waste and storm runoff, is described in the "Master Plan". The prescribed limiting frequencies have not yet been set by

the Regional Board, as they are awaiting the information contained in this Master Plan. For the purposes of the Master Plan, reductions to 8 times a year, 4 times a year, once a year, and once in 5 years were evaluated.

Solution

The Master Plan proposes that the program for the selected wet weather correction be combined with necessary dry weather treatment improvements and sewer enlargements in an overall program of new construction. The following major components would be constructed in stages that would emphasize a priority for the protection and enhancement of recreation areas:

1. A new 15-ft. diameter, five-mile long ocean outfall offshore of Fort Funston, designed to provide maximum environmental protection at all times.

2. A new 1000 million gallons per day treatment plant, westerly of Lake Merced, for wet weather treatment. The new plant would be capable of being expanded to treat all dry weather flow up to a level suitable for reclamation, including the accommodation of sanitary flows from portions of San Mateo County.

3. A system of inland and shoreline underground retention basins to retain the combined flow for subsequent treatment.

4. A tunnel transport and storage system to provide the option of intercepting, storing, and transporting flow to the new treatment plant. This would make possible the elimination of all discharges into the bay up to the selected design storm occurrence.

Whenever possible, emphasis will be given to multi-purpose design of the above storage and treatment facilities to accommodate other proposed uses such as: public vista areas, convenience stations, recreational areas and port facilities.

Financing

The cost of the combined solution to the above 3 cited problems, for the 4 alternative frequencies of uncontrolled overflows, ranges from $395 million to $864 million based upon 1974 dollars, and not considering escalation beyond that date. The cost depends on the degree of protection selected.

The Master Plan details the amount of revenue that can be generated from various percentages of the total City's uncommitted revenue resources to encompass a reasonable range for the City's commitment to this one portion of the City's total public commitment. This revenue would be in addition to the $13 million to be derived annually from the sewer service charge.

The Master Plan correlates overflow occurrence, years for completion of facilities and the percent of the uncommitted

financial resources to determine the percent grants that would be required to achieve any selected program.

For example assuming a 50% grant for the total program and a 30-year period for the completion of the facilities, the range between the lowest selected program and the highest would result in 4.8% ($18 million per year) and 12% ($38 million per year) respectively as the commitment from the City's total uncommitted financial resources. To those amounts must be added the $13 million from the sewer service charge to identify the total City commitment for waste water management.

Policy Decisions

Implementation of the proposed Master Plan will require a Board of Supervisors' policy decision on the following items:

(a) What overflow frequency should the City agree to commit itself to meet?

(b) What percent of the "Uncommitted" City resources should the City commit itself to, which, when added to the industrial waste and sewer service charge revenues, would constitute the City's total financial participation for waste water management program?

Master Plan

The Master Plan has been prepared to provide the direction and means for achieving waste water management in accordance with these policy decisions. Copies of the Summary Report and the Comprehensive Report may be reviewed at the City Engineer's Office.

TABLE OF CONTENTS

Page No.

ABSTRACT..... i

LIST OF PLATES..... viii

SECTION I - INTRODUCTION.....I-1
Flooding Control Program.....I-3
Dry Weather Program.....I-3
Wet Weather Program.....I-8
List of Supplementary Reports.....I-12

SECTION II - PUBLIC AGENCY INVOLVEMENT IN POLLUTION PROJECT.....II-1
Federal.....II-1
State.....II-2
Regional.....II-4
City.....II-5

SECTION III - EXISTING SEWERAGE SYSTEM.....III-1

SECTION IV - EXISTING TREATMENT FACILITIES.....IV-1

SECTION V - COMBINED OVERFLOW (WET WEATHER) BACKGROUND.....V-1

SECTION VI - EXISTING SYSTEM: WET WEATHER - DRY WEATHER EMISSIONS.....VI-1

SECTION VII - PROBLEM SUMMARY AND MASTER PLAN CRITERIA AND CONDITIONS.....VII-1

SECTION VIII - DATA ACQUISITION AND CONTROL SYSTEM.....VIII-1

SECTION IX - ENVIRONMENTAL EFFECT OF WASTE DISCHARGE TO THE BAY AND OCEAN.....IX-1
Oceanographic Design Criteria.....IX-3
Ecological Design Criteria.....IX-5

SECTION X-A - DRY WEATHER SOLUTION - IMPROVEMENT TO EFFLUENT QUALITY.....X-1

SECTION X-B - DRY WEATHER SOLUTION - INDUSTRIAL WASTE SOURCE CONTROL.....X-8

TABLE OF CONTENTS (Cont)

Page No.

SECTION XI - WET WEATHER SOLUTIONS.....XI-1
Treatment Plant Rate vs. Storage Capacity.....XI-2
Tunnels.....XI-5
Shoreline Retention Basin.....XI-8
Inland Retention Basin.....XI-10
Treatment.....XI-12

SECTION XII-A - THE MASTER PLAN.....XII-1
Master Plan Staging.....XII-9
Implementation of Dry Weather Program.....XII-20

SECTION XII-B - ACHIEVING MASTER PLAN CRITERIA AND CONDITIONS.....XII-33

SECTION XIII - FINANCING.....XIII-1
Historical.....XIII-1
Regional Board Requirement.....XIII-2
Grants.....XIII-4
Percent of City Resources.....XIII-6
Correlation of Variables.....XIII-11

LIST OF PLATES

PLATE* NO.	DESCRIPTION	PAGE NO.
IV-6	Locations of Adequate & Inadequate Major Transport Sewers.....	III-2
I-7	Locations of Sewered & Tributary Areas..	III-5
IV-3	Locations of Water Pollution Control Plants & Disposal Facilities.....	III-6
VIII-1	Block Diagram of S.F. Data Acquisition..	VIII-3
VI-11	Definition & Efficiencies of Treatment Levels.....	X-3
VI-12	First Cost Comparison of Expanding 3 Existing Plants vs. 1 New Plant.....	X-5
VI-9	Schematic Diagram of Wet Weather Control	XI-3
VI-8	Schematic Section of Tunnel.....	XI-6
VI-7	Perspective of Tunnel.....	XI-7
VI-10	Perspective of Inland Basin.....	XI-11
VI-15	Comparison of Wet Weather Cost vs. Accomplishments.....	XII-2
VI-1	Master Plan Alternate "A".....	XII-4
VI-2	Master Plan Alternate "B".....	XII-5
VI-3	Master Plan Alternate "C".....	XII-6
VI-4	Master Plan Alternate "D".....	XII-7
VII-2	Staging of Construction Components.....	XII-10
VI-20	Lake Merced Treatment Plant Flow Diagram	XII-23
VI-21	Lake Merced Treatment Plant Site Boundaries.....	XII-24
VI-23	Lake Merced Treatment Plant Perspective.	XII-25

LIST OF PLATES (Cont.)

PLATE* NO.	DESCRIPTION	PAGE NO.
VI-25	Location of Proposed Outfalls.....	XII-26
VI-14	Net Funds Required (1974 Million Dollars) For Total Inadequate Sewer, Dry and Wet Weather Programs.....	XII-27
VI-13	Effects of Total Cost of Immediate Compliance with E.P.A. 85% Removal Regulation.....	XII-28
IX-4	Annual Program Cost vs. Years to Complete (Various Programs).....	XIII-5
IX-3	Escalated Costs for Varying Completion Periods.....	XIII-7
IX-6	Projection of Uncommitted City Resources	XIII-9
IX-7	Revenue Produced (Millions of Dollars) for Varying Percentages of Uncommitted City Resources.....	XIII-10
IX-14	Graph of Program - Percent Uncommitted City Resources - Grants - Years for Completion.....	XIII-12
IX-15	Examples of the Use of Plate IX-14.....	XIII-14

*Plate Numbers which were extracted from the Book of Plates are consistent with Chapter Numbers of the Comprehensive Report and, therefore, are not consistent with the Section Numbers of the Summary Report.

SECTION I

INTRODUCTION

This Summary Report is to provide readers with a brief description of what is contained in the Comprehensive Report entitled "San Francisco Master Plan for Waste Water Management - September 15, 1971" or in the supporting reports. Where the Comprehensive Report and the supporting reports are written primarily for those technically involved with water quality, the attempt in the Summary Report is to translate that information in simpler terms for those readers not wholly familiar with the problems or terminology of waste water management and to summarize the important points. At the end of this Section is a list of 27 supporting reports which are elemental portions of the Comprehensive Report.

The City is deeply appreciative to those consulting engineering firms, expert consultants, and participating agency representatives that furnished information, invaluable guidance, and their time. It is certain that this total collective effort will be invaluable for the benefit of all agencies and persons concerned with waste water management.

The Comprehensive Report fulfills the objective of providing San Francisco with a short and long range plan for the solution of problems involving street flooding, sewage transport, industrial waste control and pollution control including water reclamation capabilities in a comprehensive waste water management plan. The Master Plan develops the technical solutions and corresponding costs for a wide range of possible requirements that may be established by the various federal and state regulatory agencies. This range extends to producing a quality of effluent that would be suitable for recycling or reuse as reclaimed waste water during periods of dry weather. The Master Plan includes a financial plan for the allocation of City resources to fulfill any of these objectives.

The Plan, when adopted, will serve as a basis for a long term City capital expenditure plan relative to these programs and would fulfill a requirement of the Regional Water Quality Control Board that the Board of Supervisors submit an approved Sewerage Master Plan.

Finally, the Plan would serve as the City and County of San Francisco's sub-regional element for any Bay regional plan for waste water management.

The major thrust of the Master Plan is the solution to the problem of controlling the overflow from 40 outfalls

during periods of wet weather. However, flooding control problems resulting from inadequate sewers and the need for upgrading the quality of effluent from the three treatment plants are all integrally interrelated and therefore included in the Plan.

Except where noted otherwise all costs and dollar figures are in 1974 escalated dollars.

Flooding Control Program

The City has routinely submitted bond issues for sewer enlargement and replacement over past years as a continuous program to develop the City's sewer system so that it will convey without flooding the runoff from the largest storm likely to occur in any five year period. The annual capital expenditure for program has averaged approximately $3 million. The Comprehensive Report describes that about one-half of the City's sewer system over 3 feet in diameter still is inadequate to meet this standard and that it will cost $150 million to remedy that problem. However, the Report also indicates that if the general scheme of the wet weather control program is implemented, this cost can be reduced to $100 million.

Dry Weather Program

The City has had a continuous program to treat raw sewage at each of its three primary treatment plants. Two of

these plants were completed in 1951 and one in 1938. Most of these facilities were totally financed by general obligation bonds. It is estimated that over the past 20 years the City has expended over $130 million (1971 dollars) for the construction of intercepting sewers, diversion structures, pumping stations and treatment plants. San Francisco was not eligible during the 1950s and early 1960s for federal funds for treatment facilities because the method used for determining eligibility was contingent on the applicant having an unfavorable financial condition. Even at that time the maximum federal grant for any treatment plant project was 33%. No State funds were available for financial aid until November 1970 when the State of California Clean Water bond issue provided $250 million for use with federal and local funds for waste treatment facilities. This Act provides that 25% State funds may be approved for a treatment plant project which raises the maximum federal financing from 33% to 55%, thus leaving a minimum of 20% for the discharger to finance. However, it is possible that the State Water Resources Control Board may not certify the total 80% allowable in order to distribute the grants for the maximum number of projects in the State of California.

The basic problem during dry weather has been that the effluent from the three treatment plants has not continually met water quality requirements prescribed by the Regional Board. This problem is aggravated by aging of the treatment

plants, past inability to obtain sufficient maintenance and operation funds in the annual budget and the problem of recruiting and keeping skilled operating personnel.

The Comprehensive Report describes how a violation of any requirements, for any parameter, for any day, constitutes an official and recorded violation. A continuation of that violation may result in initiation by the Regional Board of a cease and desist order, building permit ban, and/or maximum $6,000 per day fine.

In 1969 the Regional Board did impose a building permit ban on San Francisco for violations of water quality from the effluents of North Point and Southeast Sewage Treatment Plants. The City agreed to take immediate interim corrective actions and submitted to the Regional Board a detailed list of projects that would be completed by July 1973. These projects included adding low dose chemical treatment to the three primary treatment plants to improve the removal of solids, floatables, and other constituents. The commitment included a new deep water outfall now estimated to cost $7.5 million (1974) for the disposal of the North Point Plant effluent at a site near Alcatraz. Subsequent to that commitment, the City passed a $65 million bond issue (1970), of which $35 million was allocated for the above Dry Weather Program and $30 million was to be used for the initial phase of the Wet Weather Pollution Control Program.

In conformity with State requirements the City submitted a Waste Discharge Report for the new North Point outfall. New tentative requirements, more stringent than anticipated at the time the bond issue, were prepared and transmitted to the City. Simultaneously, the Environmental Protection Agency (EPA) adopted a national regulation for grant eligibility that requires the removal of at least 85% of the Biochemical Oxygen Demand (BOD) (a measure of oxygen depletion) from any wastes discharged into a body of water. Dry weather dischargers to the ocean or wet weather dischargers to any body of water can petition for a waiver of the requirement under the provisions of the regulation and such waivers are to be considered on a case-by-case basis. The staff of the State Water Regional Control Board, the Regional Board, and the State Department of Fish and Game, and this Department, all concur that the 85% BOD requirement is not a reasonable regulation in certain locations such as the North Point outfall disposal location. However, the state agencies, as the administrators of the federal grant program, have indicated that they will abide by the federal regulation and that no grant application will be certified unless the applicant receives a waiver from EPA.

Thus, the City must make an immediate decision on one of the following courses of action in order not to jeopardize

its eligibility for grants:

(a) Make the immediate decision to transport the effluent from the North Point Treatment Plant to the ocean. Increasing the treatment to provide 85% BOD removal at the North Point site is infeasible due to the additional ten acre land requirement. The cost of transporting North Point effluent to the ocean is nearly $20 million more than disposing it at the Alcatraz site.

(b) Initiate the actions that are necessary to obtain a waiver of the 85% BOD requirement for the Alcatraz site of sufficient length of time that would justify the expenditure of the $7.5 million outfall. The action necessary to obtain the waiver may be lengthy and may result in the City being unable to comply with its 1973 commitment to the Regional Board. The City intends to proceed with the latter alternative based on oceanographic and ecological evidence developed in the City's recent studies which indicate that there is justification to use the Alcatraz site for disposal of the North Point effluent with less than 85% BOD removal and because of the large expenditure of funds.

A decision must also be made as to what level of treatment is necessary for the Southeast, North Point and the Richmond-Sunset sewage treatment plants. The Comprehensive Report defines three levels of treatment; the first level is equivalent to "advanced primary" treatment which is the treat-

ment contemplated under the 1970 bond issue; the second level treatment is "intermediate" level which improves the removals of the various constituents by approximately 50% with a total BOD removal of about 70%; and the third level of treatment produces a high quality effluent suitable for reuse as reclaimed waste water. This third level of treatment would meet EPA's 85% BOD regulation for federal grant eligibility.

Wet Weather Program

The City's three treatment plants were designed to treat approximately three times the average dry weather flow. This rate accommodates the storm runoff that occurs during a light rain. When the rainfall exceeds this amount a mixture of raw sewage and storm water overflows from 40 outfalls and discharges into the Bay and Ocean along the shoreline.

In 1966 the Board of Supervisors passed a resolution establishing as policy that the City develop a means of control of its wet weather overflow. Presently, in an average year, overflow occurs 82 times for a total of 205 hours, with a total volume of 6 billion gallons. The Comprehensive Report shows that such overflow causes the emission of 42 million lbs. of suspended solids, 11 million lbs. of grease and nearly 5 million lbs. of phosphates. The cost for corrective action is dependent upon the desired reduction of

these parameters.

For the purposes of establishing a definitive objective, the Comprehensive Report studied four alternatives for frequency of overflows and developed the following results:

Alternate	Overflow Occurrence	Percent Reduction of Occurrences
A	8 times per year	90%
B	4 times per year	95%
C	1 time per year	99%
D	Once in 5 years	99+%

The alternate costs for only the wet weather portion of the Master Plan, in 1974 dollars, are respectively $333 million, $396 million, $522 million, and $665 million. These amounts do not include the cost for correcting the dry weather problems or the inadequate sewers. The cost would, of course, be lower if the overflow occurrence selected was more frequent than 8 times per year. It can be noted that decreasing the overflow occurrence from Alternate "A" to Alternate "D" results in a substantial incremental increase in cost.

The proposed Master Plan will require a Board of Supervisors' policy decision on the following items:

(a) What overflow frequency should the City agree to commit itself to meet?

(b) What percent of the "Uncommitted" City resources

should the City commit itself which, when added to the industrial waste and sewer service charge revenues, would constitute the City's total financial participation for waste water management program?

"Uncommitted" City resources are defined as the total revenues published in the Controller's Annual Report that are not committed by Charter, State Law or Local Ordinance for a specific use and also excluding revenues in the tax rate that cover the expense of welfare, education and BART.

The uncommitted City resources does not include the $13 million generated annually by the sewer service charge and industrial waste revenues which is committed to pay the expense of maintenance and operation of the waste water management programs and for interest and bond redemption of sewerage bond issues authorized through 1970.

With respect to the policy question "b" above, the Comprehensive Report shows the amount of revenue that may be generated up to a maximum of 15% of the total uncommitted City resources which represents the practical upper limit. However, it is believed that the selected percent will be within a range of from 3% to 9% and this range was studied intensively in the Comprehensive Report.

If the Comprehensive Report produces any one single conclusion, it is that to meet water quality objectives envisaged in the State Water Resources Control Boards

"Interim Basin Plan," (Reference No. 27) or in its forthcoming "Fully Developed Plan," there must be a substantial grant-in-aid program available for wet weather control facilities, as well as the continuing grant program for dry weather.

The statement of Senator John V. Tunney in his July 16, 1971, letter to William J. Ruckelshaus, Administrator of EPA, expresses this point clearly in which he states:

"I believe that it is essential for the Federal Government to make an all out effort to encourage the affected cities to deal with their storm water pollution problems and to provide those cities with appropriate federal financial assistance in that connection."

Finally, it must be emphasized, that neither the Comprehensive Report, nor its supporting reports, specifically responds to the question as to what degree of treatment both during wet and dry weather periods is justifiably reasonable and necessary to protect the beneficial uses of the bay or ocean when correlating that degree with cost. The Comprehensive Report assumes that the regulatory agencies can defend the establishment for its prescribed water quality objectives and the Report concentrates on means to achieve those objectives.

SUPPLEMENTARY REPORTS

Ref. No.	Title	Date	Prepared By
1	San Francisco Comprehensive Master Plan Report (preliminary)	9/71	(1)
2	San Francisco Comprehensive Master Plan Report - Book of Plates (preliminary)	9/71	(1)
3	Characterization and Treatment of Combined Sewer Overflows	11/67	(2)
4	Alternate Methods of Effluent Disposal	2/69	(3)
5	Prefeasibility Study - Sewer Tunnel Project for the City of San Francisco	5/70	(4)
6	Study of Chlorine Demand and Toxic Wastes Discharged to San Francisco's Southeast Sewage Treatment Plant	9/70	(5)
7	Review of Biological, Literature on Pacific Coast Marine Waste Disposal as a Guide to Prediction of Ecological Effects of a Submarine Outfall in the Gulf of the Farallones	12/70	(6)
8	Watershed Model and Sewer Model	4/71	(7)
9	Water Quality Transport Model	5/71	(7)
10	Dissolved Air Flotation Project Report	7/71	(2)
11	Dissolved Air Flotation - Appendix A - Pre-construction Studies on Quality and Quantity Relationships of Combined Sewage Flows and Receiving Water Studies at Outer Marina Beach	7/71	(2)
12	Dissolved Air Flotation - Appendix B - Technical Objectives for Field Demonstration of Baker Street Dissolved Air Flotation Facility	7/71	(2)

SUPPLEMENTARY REPORTS (Cont.)

Ref. No.	Title	Date	Prepared By
13	Dissolved Air Flotation - Appendix C - Treatment of and Dilute Raw Sewage with the Dissolved Air Flotation Process - A Pilot Plant Study	7/71	(2)
14	Dissolved Air Flotation - Appendix D - Design Factors for Baker Street Dissolved Air Flotation Facility	7/71	(2)
15	Dissolved Air Flotation - Appendix E - Cost for Dissolved Air Flotation Facilities	7/71	(2)
16	Dissolved Air Flotation - Appendix F - Characterization of the Receiving Water	7/71	(2)
17	Dissolved Air Flotation - Appendix G - Performance Evaluation of Baker Street Facility with Raw Sewage	7/71	(2)
18	Report on Water Pollution Control Plants - Report 1 - Phase I - Existing Operations and Plant Performance	9/71	(3)
19	Report on Water Pollution Control Plants - Report 1 - Phase II - Evaluation of Incremental Levels of Effluent Improvements	9/71	(3)
20	Report on Water Pollution Control Plants Report 2 - Phase I	9/71	(3)
21	Report on Water Pollution Control Plants - Report 2 - Phase II	9/71	(3)
22	Report on Water Pollution Control Plants Report 3 - Phase I	9/71	(3)
23	Report on Water Pollution Control Plants - Report 3 - Phase II	9/71	(3)
24	City & County of San Francisco, A Predesign Report of Marine Waste Disposal, Oceanographic and Base Data Acquisition and Evaluation of Alternate Locations	9/71	(3)

SUPPLEMENTARY REPORTS (Cont.)

Ref. No.	Title	Date	Prepared By
25	Survival of Dungness Crab Larvae in Two Concentrations of San Francisco Sewage Effluent	2/70	(8)
26	Interim Water Quality Control Plan, San Francisco Bay Basin	6/71	(9)
27	San Francisco Bay Delta Water Quality Control Program, Final Report	6/69	(10)

(1) San Francisco Department of Public Works

(2) Engineering-Science Incorporated

(3) Brown and Caldwell

(4) Bechtel Incorporated

(5) URS Research Company

(6) Dr. Wheeler J. North

(7) Water Resources Engineers, Incporated

(8) Dr. George Schuman, Marine Associates

(9) California Regional Water Quality Control Board
San Francisco Bay Region

(10) Kaiser Engineers

SECTION II

PUBLIC AGENCY INVOLVEMENT IN POLLUTION PROJECTS

Every water pollution project is subject to review and action by Federal, State, Regional, City and other agencies. From conception to completion of construction a project involving work within the San Francisco Bay region is subject to the review, modification, or total rejection, of numerous agencies in the process of obtaining certification, permits and approvals. The following list outlines agencies involved and briefly their functions and interrelationships relative to obtaining water pollution control project approvals:

A. Federal

1. Environmental Protection Agency (EPA)
    a. Establishes national water quality standards.
    b. Administers federal grant financing program.
    c. Requires State Water Resources Control Board approval prior to taking action.
    d. Issues construction permits.

2. U. S. Army Corp of Engineers

   a. Implements 1899 Refuse Act controlling discharge to navigable water by industries and municipalities.

   b. Controls work in navigable waters through construction permits.

   c. Requires Regional Water Quality Control Board, Bay Conservation and Development Commission, and San Francisco Port Commission approvals prior to taking action.

   d. Post public notice of project for public agency and private parties disagreement.

3. Department of Interior, Bureau of Sport Fisheries

   a. Reviews ecological effect.

   b. Acts through EPA and Corps of Engineers.

B. State

1. Water Resources Control Board (SWRCB)

   a. Administers state grant financing.

   b. Certifies projects for federal grant financing.

   c. Collates parallel and sub-agency recommendations relating to:

1. Public Health
2. Regional water quality
3. Ecological effect
4. Navigation
5. Land use

2. Department of Public Health (DPH)
   a. Project review and acts via Regional Water Quality Control Board.
3. Regional Water Quality Control Board (RWQCB)
   a. Establishes discharge requirements.
   b. Monitors compliance - can fine violators ($6,000/day maximum) and impose construction ban.
   c. Issues project certification for federal grant financing.
   d. Requires Bay Conservation and Development Commission approval.
4. Department of Fish and Game (DFG)
   a. Project review and acts via Regional Water Quality Control Board.

b. Recommends discharge requirements to Regional Water Quality Control Board.

c. Laboratory work.

5. Department of Navigation and Ocean Development

a. Project review.

b. Recommends to Regional Water Quality Control Board.

6. State Lands Commission

a. Right of way (State land).

b. Mineral rights.

c. Requires Corps of Engineers approval.

7. Bay Conservation and Development Commission (BCDC)

a. Project review - use of lands affected by ebb and flow of tide.

b. Permit required.

c. Requires Regional Water Quality Control Board and San Francisco Port Commission approvals.

C. Regional

1. Association of Bay Area Governments (ABAG)

a. Project approval required for 10% of federal

grant financing.

b. Metropolitan/regional clearinghouse.

c. Comprehensive regional planning agency.

2. Bay Area Sewage Services Agency (BASSA)

a. Pending legislature for the establishment of this agency.

b. Approval requirement.

D. City

1. City Planning Commission

a. Project review.

b. Approval required.

2. San Francisco Port Commission (approval required if on Port land)

a. Project review.

b. Agreement required with City.

c. Permit required.

3. Recreation and Park Department

a. Approval required if on park land.

4. San Francisco Art Commission

a. Architectural approval for structures.

SECTION III

EXISTING SEWERAGE SYSTEM

San Francisco has a "combined" sewerage system, that is, a system where the sanitary sewage and industrial waste discharges are conveyed in the same sewer pipes which carry storm drainage. This system, as differentiated from a "separate" system, is typical of older communities where in earlier times sewers were first constructed to convey storm runoff and were used later for conveyance of domestic and industrial wastes as well. San Francisco's entire public sewer system consists of approximately 1,000 miles of sewers ranging in size from 8 inches in diameter to a multi-barrel sewer 10 feet high by 40 feet wide. Approximately 3/4 of the sewers are presently less than 3 feet in diameter. In the early stages of construction of the system not all sewers were sized to accommodate the City's present design standard of collecting and transporting that flow caused by storms, the runoff from which would only be exceeded and result in possible flooding only once in five years or less frequently. Thus, the sizes of many of the sewers in the existing system, are not adequate to transport the flow emating from a storm occurring once in five years as shown on

CITY & COUNTY OF SAN FRANCISCO
LOCATION OF ADEQUATE & INADEQUATE
MAJOR TRANSPORT SEWERS

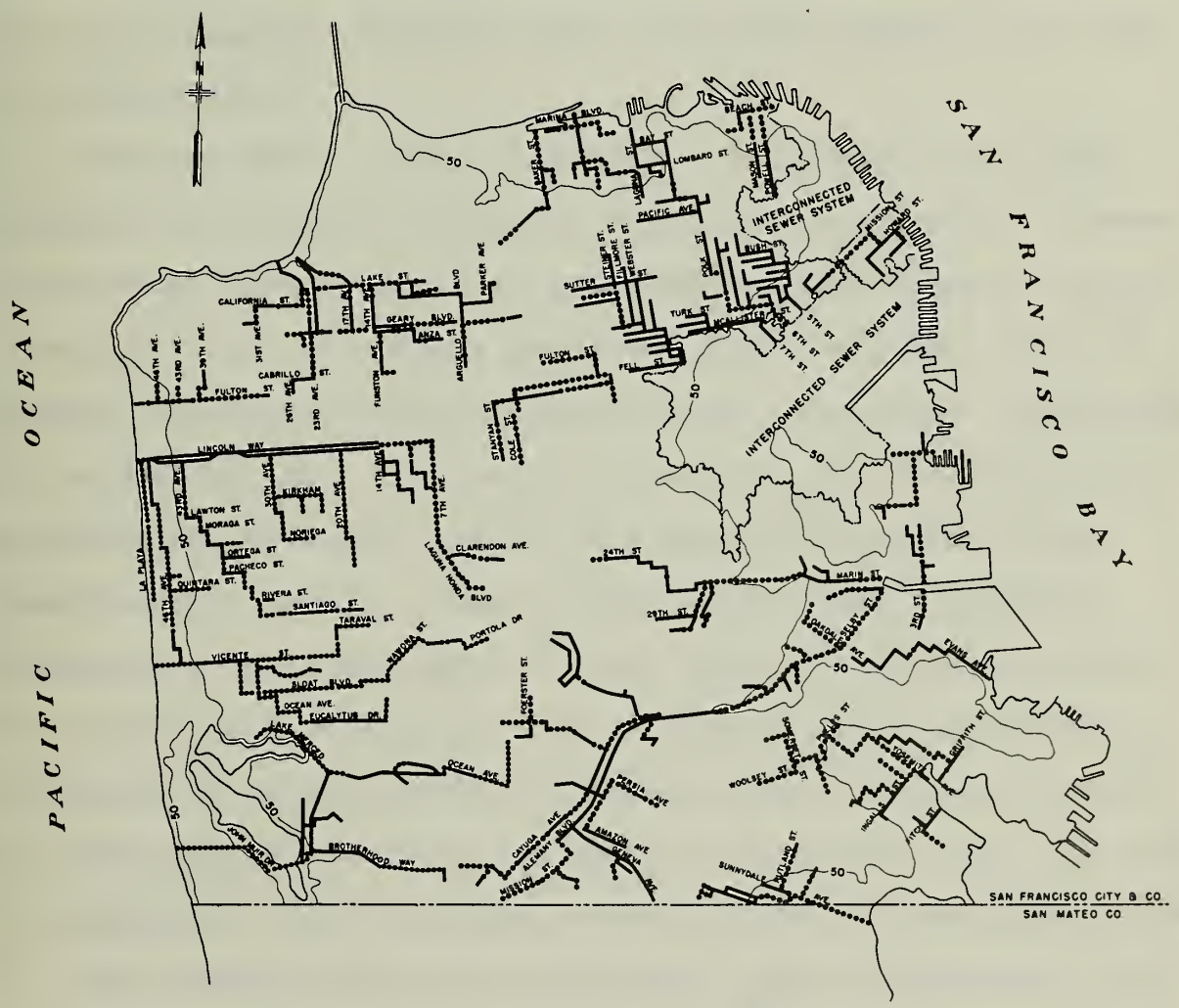


Plate IV-6. It is concluded in the Comprehensive Report that approximately 45% of sewers 3 feet in diameter and larger are inadequate to meet the present design standard and that it will cost $77 million to enlarge those sewers. No detailed study has been made of the inadequacy of the smaller sewers, but it is roughly estimated that this would increase the cost to $150 million.

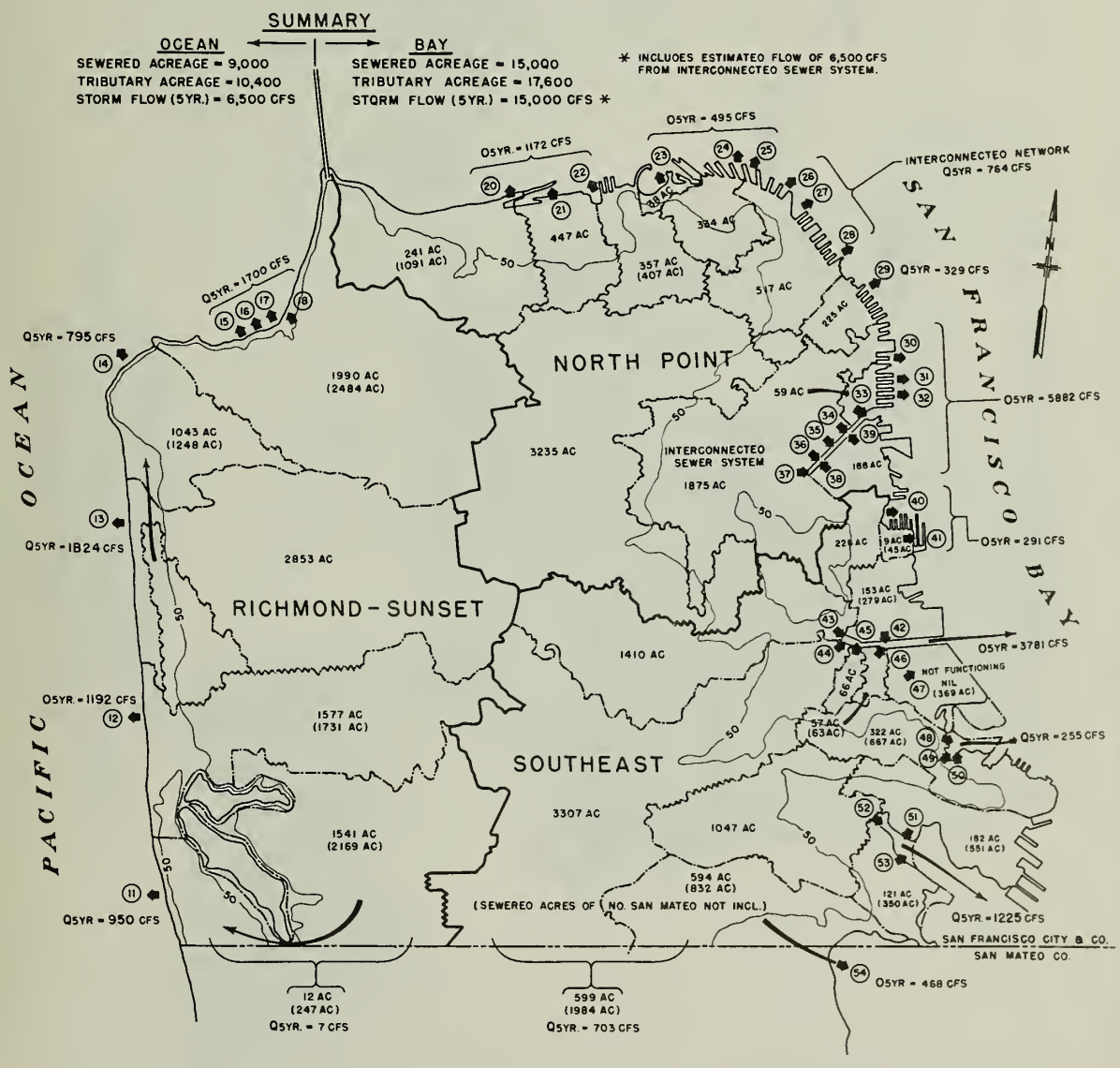
The program for sewer enlargement or extension has been financed in the past by general obligation bond issues. These bond issues have occurred at intervals of approximately every five years with an average magnitude of $15 million, thus financing an average of $3 million per year for sewer enlargement or reconstruction. This work of providing the facilities for flooding and drainage control is discussed in detail in the Comprehensive Report. When a storm occurs with a rainfall intensity greater than once in five years, or where the sewer is "inadequate", the excess runoff travels along the gutters, sidewalks or streets until it reaches either a location where the sewer can accommodate the flow or in certain cases the flow is discharged from the street directly into the receiving waters.

The sewerage system also includes 25,000 catchbasins functioning as inlet receptacles for storm runoff. The purpose of these catchbasins is to trap heavy material flushed from the

streets during wet weather in order to protect the sewer system. During the fiscal year 1969-70, $261,500 was spent cleaning these catchbasins. Ironically, while the catchbasins provide some protection to the sewerage system and treatment facilities, which was all that was of interest in past years, they aggravate the wet weather pollution control problem by discharging slugs of accumulated material during wet weather periods. The use of catchbasins give rise to many complaints of odors and mosquito breeding during dry weather periods.

The storm water entering into the combined sewerage system mixes with the sanitary waste, as previously described, and the combined flow is diverted from over 43 outfalls or trunk sewers, as shown on Plate I-7. This mixture is treated at one of the City's three treatment plants up to a rate equivalent to a light rain or approximately three times the average dry weather rate. The treatment plant tributary areas and locations are shown on Plate IV-3. The treatment plants now treat approximately 30% of the average annual amount of storm water runoff. When the combined capacity of three treatment plants (340 million gallons per day - mgd) is reached, all of the mixture in excess of that amount overflows the diversion structures to the Bay or Ocean at the 43 outfalls located along the City's shoreline. The existing system results in an average of 82 overflows per

CITY & COUNTY OF SAN FRANCISCO
SEWERED & TRIBUTARY AREAS



NOTE: AREAS WHERE ONLY ONE SET OF FIGURES IS SHOWN INDICATES SEWERED AND TRIBUTARY ACREAGES ARE THE SAME.

CITY & COUNTY OF SAN FRANCISCO
LOCATION OF TREATMENT PLANTS, THEIR OUTFALLS, AND APPROXIMATE AREA BOUNDARIES

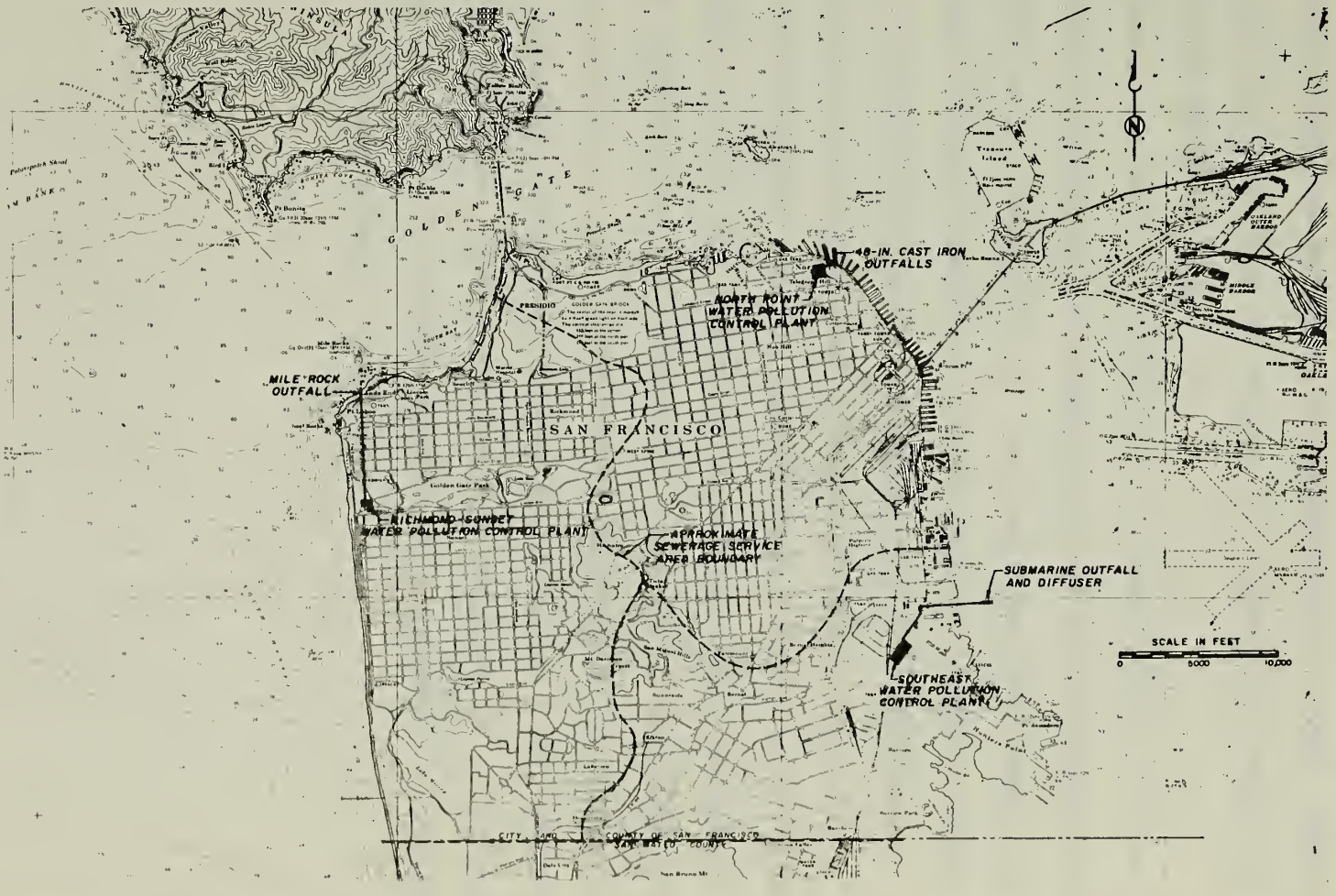


PLATE IV-3

year. The number, hours and volume of combined storm and sanitary discharge from the existing 82 overflows per year compared to Master Plan Alternatives to reduce the number of overflows is described in Section VII.

The program to control "pollution" (a word which will be defined later in this report) resulting from wet weather overflows, is discussed thoroughly in the Comprehensive Report as the City's Wet Weather Program. It was the wet weather problem, and its relationship with pollution control problems during dry weather periods, that precipitated the need for a comprehensive pollution control Master Plan. Funds were first made available for the Wet Weather Program in 1964, when $1.5 million was approved from a 1964 bond issue for a demonstration wet weather facility - the Baker Street Dissolved Air Flotation Facility. This was later followed by approval of a $65 million bond issue in November 1970, of which $30 million is to finance the first major step for implementation of a program for abating wet weather combined sewage overflows.

SECTION IV

EXISTING TREATMENT FACILITIES

As early as 1938, twelve years prior to the formation of any enforcement agency for pollution control, San Francisco completed the Richmond-Sunset Sewage Treatment Plant in Golden Gate Park near Lincoln Way and 48th Avenue as the first of three primary sewage treatment plants to treat the sewage from the City. The effluent from this plant which services a tributary acreage of 9,000 acres, is discharged near the shore at Mile Rock near Lands End. This plant was enlarged in 1948 and improvements have been made periodically over subsequent years.

In 1951 the North Point Sewage Treatment Plant was completed near Bay and Kearny Streets. This plant, servicing the northeasterly portion of the City, approximately 7500 acres, also treats sewage to a primary level and discharges a disinfected effluent through pipes under Piers No. 33 and 35 at a depth of approximately 12 feet.

The Southeast Sewage Treatment Plant, located near Jerrold and Phelps Street, and servicing an area of about 7500 acres, was completed in 1951 and originally its effluent was discharged westerly of the 3rd Street at Islais Creek. This plant also receives and processes the

solids from the North Point plant. In 1969 the effluent from this treatment plant was extended into San Francisco Bay approximately 700 feet offshore of the extended Army Street Terminal facilities. The location of these plants is illustrated on Plate IV-3, page III-6. Some of the basic characteristics of these three plants are tabulated below:

Existing Constituent Removals

A. RICHMOND-SUNSET PLANT

Average Flow 20 mgd; Peak Flow[1] 70 mgd:
Service Area 9,004 Acres

	(Biochemical Oxygen Demand) million lbs/yr	(Suspended Solids) million lbs/yr	Grease million lbs/yr
Influent	11.4	9.1	2.8
Effluent	8.2	3.8	2.2
Percent Reduction	28	62	21

B. NORTH POINT PLANT

Average Flow 60 mgd; Peak Flow [1] 200 mgd;
Service Area 7,516 Acres

	(Biochemical Oxygen Demand) million lbs/yr	(Suspended Solids) million lbs/yr	Grease million lbs/yr
Influent	44.7	32.7	10.5
Effluent	29.5	13.4	5.6
Percent Reduction	34	59	47

C. SOUTHEAST PLANT

Average Flow 20 mgd; Peak Flow [2] 70 mgd;
Service Area 7,494 Acres

	(Biochemical Oxygen Demand) million lbs/yr	(Suspended Solids) million lbs/yr	Grease million lbs/yr
Influent	14.2	18.5	6.8
Effluent	10.1	12.6	3.9
Percent Reduction	29	32[2]	43

(1) Based on hydraulic capacity
(2) Affected by solids contribution from North Point Plant

Primary treatment, as provided by the City of San Francisco at the three aforementioned locations, consists of the following major operational sequences.

1) Screening - Removal of gross material such as rags, paper, cans and other material, with disposal to land fill.

2) Grit Removal - Removal by short term sedimentation (gravity settling) of sand with disposal to land fill.

3) Primary Sedimentation - Removal of almost all settleable matter coupled with a percentage of suspended matter by gravity settling and floatable removal over a period of 1-2 hours. Solids are then stabilized by digestion, dewatered and disposed of by land fill.

4) Disinfection - Using chlorine to achieve safe bacterial concentrations before discharge to receiving waters.

Treated primary effluent has a brownish color and except

when discharged into deep water through a submerged outfall diffuser system, will cause some discoloration of the receiving water. Primary treatment, by virtue of its removing the settleable matter, would reduce the biological oxygen demand (BOD) by 25-35%. BOD removal, which directly affects the amount of dissolved oxygen in the water, was the main indicator for pollution control in the sanitary engineering field in the past, and is still considered one of the most important single indicators by the Federal Environmental Protection Agency. The removal of BOD, however, is not significant for discharges to bodies of water with large oxygen resources such as the central Bay. Of more importance as indicators are the constituents which damage the marine environment such as heavy metals and toxic materials.

A table of the expected process performance for various treatment methods, prepared for the San Francisco Bay-Delta report, is tabulated below for comparison with existing efficiencies for the City's plants as described on pages IV-2 and IV-3.

WASTEWATER TREATMENT PROCESS PERFORMANCE

Treatment Process	Suspended Solids (1)	Floatables (1)	5-Day, 20°C. Biochemical Oxygen Demand (1)
Primary Treatment			
Conventional	60-70	50-60	25-35
Advanced	55-65	60-70	40-50

(1) Percent Removal

Treatment Process	Suspended Solids (1)	Floatables (1)	5-Day, 20°C. Biochemical Oxygen Demand (1)
Intermediate Treatment			
Chemical, Chlorination;	80-90	70-80	50-70
with Filtration	85-95	80-90	70-80
Secondary Treatment			
Activated Sludge,			
Chlorination;	85-95	75-85	85-95
with Filtration	95-98	85-95	90-97
Tertiary Treatment			
Chemical Filtration, Chlorination, Additional Chemical and Activated Carbon	99	99	99
Activated Sludge, Filtration, Chlorination, Tertiary Chemical and Activated Carbon	99	99	90-95

(1) Percent Removal

Today, technology has surpassed past sanitary engineering practice and concern is given to less traditional effects of waste discharges upon all areas of water quality. Evaluation of the chronic effects of biostimulants, toxicants and trace materials such as mercury, lead and pesticides upon the ecological balance of the receiving waters is one of the areas of major endeavor today. The ultimate goal is the elimination of any adverse effect of waste disposal. Included in this set of goals is the aesthetic enhancement of the receiving waters and the provision of a safe, enjoyable environment for all the uses of the Bay community. These goals are of primary concern in

the development of the City's Master Plan. Direction in this regard is provided to all dischargers in the State through the State Water Resources Control Board and the Regional Water Quality Control Boards.

In 1950, with the passage of the Dickey Act, the State Water Resources Control Board, with its nine Regional Water Quality Control Boards, was formed. Its basic responsibility is to establish through the Regional Board system, the beneficial uses of the State waters and to prescribe water quality requirements that would protect the waters for those uses. The Boards were also charged with the responsibility of establishing policy for long-range water quality objectives and to develop a program for the enforcement of these requirements.

In the early 1950's the major emphasis for water quality requirements was usually limited to numerical limits for bacteriological levels and dissolved oxygen in the receiving waters. This was consistent with the"state of the art" and level of knowledge regarding water pollution control at that time. A violation of these numerical limits was considered a case of "pollution".

Since 1950 the Regional Water Quality Control Board has continued to upgrade discharge requirements as a result of more field measurements of water quality, to increase the scope of discharge requirements and to make existing requirements more

Resolution No. 84 - 1951		Tentative Resolution dated July 8, 1971		Anticipated Future Requirements	
Numerical Limits	Subjective Restrictions	Numerical Limits	Subjective Restrictions	Numerical Limits	Subjective Restrictions
a. Dissolved Oxygen	a. Grease	a. Dissolved Oxygen	a. Floatable Material	a. Dissolved Oxygen	a. Odors
b. Bacterial Value of the Receiving Water	b. Floatable Material	b. Dissolved Sulfides	b. Bottom Deposits	b. Dissolved Sulfides	b. Any Evidence or Effect of any Waste Discharge
	c. Sludge Deposits	c. Bacterial Value of the Receiving Water	c. Temperature	c. Bacterial Value of the Receiving Water	
	d. Odors	d. Turbidity	d. Oil of Petroleum Nature	d. Turbidity	
		e. pH(acidity)	e. Odors	e. pH(acidity)	
		f. Settleable Matter		f. Settleable Matter	
		g. Lead		g. All heavy metals	
		h. Copper		h. Grease	
		i. Grease		i. Toxicity Effect in the Receiving Water	
		j. Toxicity Effect in the Receiving Water		j. Floatable Material	
				k. Bottom Deposits	
				l. Temperature	
				m. Oil of Petroleum Nature	
				n. Nutrients	
				o. Toxicity of Waste Stream	
				p. B.O.D.	
				q. Mercury	

stringent. For example, the scope of the requirements now under consideration for the North Point Treatment Plant, as compared to those established for North Point in 1951 is shown in the tabulation on page IV-7.

It should be emphasized that any violation of any requirements for any one day is technically considered to be "pollution" resulting from that discharge and a continued violation would be subject to enforcement action of the Regional Board.

Because of the periodic changes to the discharge requirements, meeting a certain water quality parameter at any one time does not insure that the discharger will not be in violation of the requirement at some time in the future.

Dischargers such as the City of San Francisco have, in effect, been faced with complying with a moving target in the sense of maintaining compliance with the established requirements. While in some instances a potential target for compliance could be anticipated by reference to long-range policy statements of the Regional Board, there are cases where requirements have been imposed that could not have been anticipated with reasonable foresight. Thus each discharger is confronted with the problem of planning, funding, and constructing projects to meet present and future water quality requirements and goals while under rigid Regional Board time schedules for completion. Within this framework of limited knowledge concerning future

requirements, and "crash program" time schedules to meet present requirements, it is extremely difficult to develop a staged construction and improvement program that will minimize premature facility obsolescence and maximize the benefit of funds expended. This problem becomes further aggravated by the deterioration of the existing plants due to age and the unavailability of sufficient maintenance funds. This latter problem was alleviated by the City in August 1971 by passage of a sewer service ordinance which is expected to insure the funds necessary for proper maintenance and operation.

In addition, from 1948 to 1970, a portion of each sewerage bond issue has been allocated for improvements to the treatment plants. It is estimated that over $130 million (1971 dollars) was spent in this period for treatment plants, pumping stations and "interceptor" (not collection) sewers.

In November 1970, the voters approved a $65 million bond issue of which $35 million was to provide the facilities necessary to meet the Regional Board's requirements in existence at that time. The Comprehensive Report delineates those projects and facilities necessary to meet various levels of effluent quality in the future. This description is referred to as the Dry Weather Program.

SECTION V

COMBINED OVERFLOW (WET WEATHER) BACKGROUND

Prior to 1967 the Regional Board's primary concern relative to San Francisco was the initiation of improved effluent quality from the three treatment plants. Subsequently more emphasis was placed on the effects of overflows from the combined sewerage system on the contiguous waters of the Bay and Ocean.

By this time the City's Department of Public Works had already evaluated the feasibility and practicality of "separating" the City's combined sewer system via the construction of a separate conduit for domestic and industrial wastes and use of the existing system for storm runoff. The conclusions reached indicated that it was inadvisable to separate the system and more desirable to treat and control the combined overflow. This conclusion was based on the following:

1. Storm water from a separated system contains significant pollutant loadings that would be discharged to the receiving waters.

2. Assuming that the Regional Board will never impose water quality requirements on storm water discharges (which is an unlikely assumption as the Porter-Cologne Act gives the Regional Board that authority and in the "Interim Water Quality

Control Plan, San Francisco Bay Basin," June 1971, the Regional Board set policy which encompasses the control of storm water discharges), the cost to construct a separate system was estimated in 1968 to cost $1.4 billion dollars versus the cost of providing combined overflow control and treatment at a cost of $100 million. This latter figure is much lower than estimates made for the Comprehensive Report due to the need and provision for higher levels of treatment and the capability of accommodating storms of greater overflow frequency.

The $1.4 billion cost for separating the sewers, escalated to $2.2 billion (1971 dollars) included the cost of separate internal plumbing from roof drains, but did not include the tremendous disruption and expense to City services, business loss, and utilities.

3. Federal and State financial aid were available for treatment facilities but not for sewer separation.

4. Ultimately it is anticipated that the control of emissions from separate storm runoff systems will be required.

Based on the above conclusions, in December 1966 the Board of Supervisors adopted by resolution, a policy to continue the combined sewer system and directed the Department of Public Works to initiate a program for treating and controlling wet weather overflows.

Pursuant to that policy, the City applied for and received a Federal research grant in the amount of $99,821 (75% of the total project cost) to characterize combined overflow. The City engaged the firm of Engineering Science, Inc. for this work, and the results of this study, (Reference No. 3), provided detailed information on the constituent make-up of combined sewer overflow for various land uses. The study developed first estimates of constituent emissions from combined overflows and concluded, based on laboratory bench scale work, that a process called "dissolved air floatation" presented a potentially feasible and economical method of removing the type of constituents believed necessary to meet anticipated Regional Board wet weather requirements.

Based on these conclusions, the City applied for and received a Federal facilities demonstration grant of $921,000, representing approximately 30% of the eventual project cost, to construct a full scale 24 mgd (about 0.1% of the City's total 5-year storm runoff), demonstration facility on the Baker Street outfall in the Marina, and to conduct a pre-evaluation of the receiving waters, a post-evaluation of the performance of the facility and pilot scale testing during wet and dry weather periods. Also included was a determination of the effect to the receiving waters and the development of capital costs for treating other flow rates by dissolved air

flotation.

The City retained the firm of Engineering Science, Inc. to design a facility that satisfied the combined objectives of pollution control, aesthetic quality, recreational and public use. The facility architectural design was subsequently granted commendation by the San Francisco Art Commission. The reports covering the design features, performance and costs are set forth under References 10 through 17. Unfortunately, the limited rainfall during the 1970-71 winter season resulted in only limited full scale operation. However, based on this and the pilot plant work, as described in the Comprehensive Report, it is concluded that dissolved air flotation process does compare favorably, particularly for the removals of "floatables," with conventional primary treatment.

Simultaneously with above projects, studies were initiated concerning the use of storage facilities for overflow control, oceanographic evaluation of discharge locations, and hydrological evaluations of the City's rainfall history. Dry weather treatment studies are also in progress. All of these were melded together to produce the proposed Master Plan and are fully described in the Comprehensive Report.

SECTION VI

EXISTING SYSTEM: WET WEATHER - DRY WEATHER EMISSIONS

Data from the studies and evaluations cited in the previous section and from the City's on-going operational monitoring programs has been brought together to define the existing system emissions and control levels. Presently it is anticipated that existing requirements for the treatment plants can be met by providing low dose chemical treatment at each plant. The effect of this planned improvement has been evaluated and also compared to the overall existing condition. The following table shows a tabulation of total emissions from combined overflow during an average year compared to primary treated effluent (including that portion of the wet weather that was treated) for the 1969-1970 fiscal year and also to the effluent anticipated to be attained by utilization of low-dose (25-50 mg/l) chemical treatment with ferric chloride. The flow shown in the first column is as measured in the 1969-70 year and in the second column the flow is as anticipated when the plants are run at hydraulic capacity during wet weather plus the present dry weather flow.

Flow	Primary Treatment 1969-1970 Fiscal Year	Anticipated Low-Dose Chemical Treatment (per year)	Existing Untreated Combined Sewer Overflow (per year)
Flow (billion gallons)	36.8	38.8	6.0
C.O.D. (million pounds)	116	112	13.6
B.O.D. (million pounds)	46.7	45.0	2.6
Suspended Solids (million pounds)	30.7	18.1	23.6
Floatables (million pounds)	N/A	0.26	0.207
Grease (million pounds)	13.7	9.37	1.38
Phosphorus (million pounds)	9.0	4.46	0.290
Nitrogen (million pounds)	11.2	9.65	0.726

It can be seen that the combined overflow actually contributes a small percentage of the total emissions, with the exception of suspended solids and floatables as compared to that which is discharged into the receiving waters from the three existing primary plants. Thus, based upon the preceding table, it is apparent that control of combined overflows will not result in significant reductions to mass emissions from the City, except in the area of solids and floatables discharges. In general these emissions can be related to aesthetic pollution

such as materials of sewage origin found on the shoreline and receiving water discoloration.

One other measure of combined sewer overflow pollution is the bacteriological quality of the water as related to water contact sports standards. It is estimated that the existing overflows result in about 171 days of non-compliance in the receiving waters with the existing standards. This is probably the most significant factor relative to combined overflow pollution that will be reduced by implementation of the Master Plan system.

SECTION VII

PROBLEM SUMMARY AND MASTER PLAN CRITERIA AND CONDITIONS

The following conditions summarize the total waste water management problems facing San Francisco. The Master Plan has been developed to encompass these problems and resolve them by one complete solution with enough built in flexibility to be capable of revision without loss of previous investments.

1. Inadequate Sewers: Much of the City's sewerage collection system is inadequate to accomodate the design storm flow (based on a 5-year recurrence interval). Any program for the control of wet weather conditions must consider the existing conveyance system deficiencies. It has been determined that provision of storage facilities at appropriate locations will eliminate some of the existing inadequacies. The Master Plan wet weather facilities are estimated to substantially reduce this system inadequacy.

2. Wet Weather Control: The Regional Board, in its requirements and in reference to the State's Interim Basin Plan, does not place an upper or lower limit for the number of overflows, number of hours of overflow or storm intensity that will be required for wet weather control. It was decided, after discussions with the staff of the Regional Board, to evaluate the alternates of overflow frequencies 8 times/year, 4 times/year, 1 per year, and once per 5 years.

3. Dry Weather Program: There is an existing program for improving the quality of effluent at the three treatment plants. The program is consistent with the commitment made to the Regional Board in 1970 to complete by July 1973 those facilities necessary to upgrade the treatment plant effluent using chemical treatment. These facilities are being financed by a portion ($35 million) of the $65 million 1970 water pollution bond issue. This was predicated on the use of low dose ferric chloride and included new deep water outfalls for the North Point and Richmond-Sunset Plants.

Subsequently, the Regional Board adopted its Interim Basin Plan, a forerunner of the State of California's Fully Developed Basin Plan, which clearly alludes to future requirements which cannot be met by low dose chemical treatment, but more likely equivalent to a water quality suitable for potential reclamation usage. Such potential uses range in quality from that of irrigation reuse to that for direct water contact sports and ultimately drinking water. Requirements for toxicity, grease and other such constituents might be made significantly more stringent than present limits. Higher levels of treatment would then be required to attain these goals. The adoption of such requirements will make many of the improvements now contemplated obsolete or of less value and at the same time require extensive new

facilities. It is possible that these higher requirements will be prescribed within the next several years. This situation necessitated the investigation of the alternatives described under the Dry Weather Program of the Comprehensive Report. The Interim Basin Plan also states that the long range policy goal is to provide maximum feasible reclamation and reuse of municipal, industrial and agricultural waste waters.

Finally, the Environmental Protection Agency has published a new regulation requiring treatment plants to attain a minimum of 85% BOD removal (high level treatment) in order to be eligible for federal grant financing (and therefore also State grants). This new regulation does provide for a waiver of the 85% BOD requirement for ocean disposal and wet weather discharges. This will have a drastic effect on all present plans for Bay disposal. There has been no indication that the proposed North Point outfall near Alcatraz will be considered an "ocean" outfall even though the receiving water conditions there are similar to those of "open" ocean waters. Clarification of this point is being sought from the Environmental Protection Agency and the results will have a significant impact upon the City's present program.

Finally, for both dry and wet weather disposal, a problem of the toxic effects of industrial discharges now

exists, particularly for those constituents which are not readily removed with treatment. In 1971 the City Board of Supervisors enacted a new Industrial Waste Ordinance directed at the reduction of these toxic waste discharges. It is expected that with full enforcement of this ordinance, the toxic waste problem will be solved, at least in large measure.

In developing the Master Plan to each of the above areas of concern, certain criteria or conditions emerged which guided the Master Plan development as presented in this report. These are as follows:

1. The Plan should provide for facilities such that the waste discharges into the bay or ocean will not have an adverse effect on the marine life or other beneficial uses of the water or beaches.

2. The Plan should be flexible but comprehensive to meet changing discharge requirements, possible long range needs for reclaimed waste water, and the City's financial capability. This flexibility must take the form of a "building-block" to minimize the possibility of early abandonment and to accommodate the ever increasing emphasis on preservation of our aquatic environment.

3. The Plan should reflect the direction of the City Planning Commission, Bay Conservation and Development Commission, and concerned civic organizations by not adversely affecting

future development of San Francisco, particularly with respect to utilizing excessive valuable property for treatment facilities. This would include, if practical and economical, the possible release of existing valuable land acquisitions, such as the Golden Gate Park and the north waterfront area, (Richmond-Sunset Water Pollution Control Plant and North Point Water Pollution Control Plant respectively), and substitute use of these areas for those in lesser demand. The Plan should have the capability for consolidation of facilities where practical. Multi-use facility planning must be given significant consideration.

4. The Plan should provide for a feasible financial plan and time schedule by establishing a policy for a yearly commitment of City funds achievable by San Francisco financing alone or an expedited program to the extent that federal or state grants are available. The financial plan must recognize: routine, but always increasing, maintenance and operation costs; need for replacing inadequate sewers; replacing sewers that have structurally failed; upgrading plant effluent by reducing emissions; replacing worn-out equipment and structures at the plants; and controlling wet weather discharges.

5. The Plan should attempt to provide a cost-benefit relationship in order that a policy may be established as to the degree of treatment that should be contemplated during

periods of wet weather. The benefits would include:

a) Provision for immediate upgrading of existing treatment plants effluent quality;

b) Provision for a substantial reduction in flooding of City streets;

c) Provision for a substantial reduction of emissions due to occurrences of combined overflows;

d) Provision for a viable industrial waste program that will control toxic discharges at the source;

e) Provision for the capability of prohibiting, within the design limit adopted, all combined overflow discharges into San Francisco Bay.

6. The Plan should, as the San Francisco Sub-Regional Waste Water Management Plan, be capable of being an element of, and compatible with any bay area regional plan including the capability of accepting the effluent from other dischargers, cities, or districts in San Mateo County, within the design limits of the system, to facilitate a regional consolidation plan. This should include the ultimate regional objectives of discharge consolidations and maximizing waste water reclamation potential.

7. The Plan should take maximum advantage of the City's hilly topography for underground storm storage and transport.

8. The Plan should include a central control system so that dry weather flow, or wet weather street drainage can be

effectively managed from surface runoff to treated overflow.

SECTION VIII

DATA ACQUISITION AND CONTROL SYSTEM

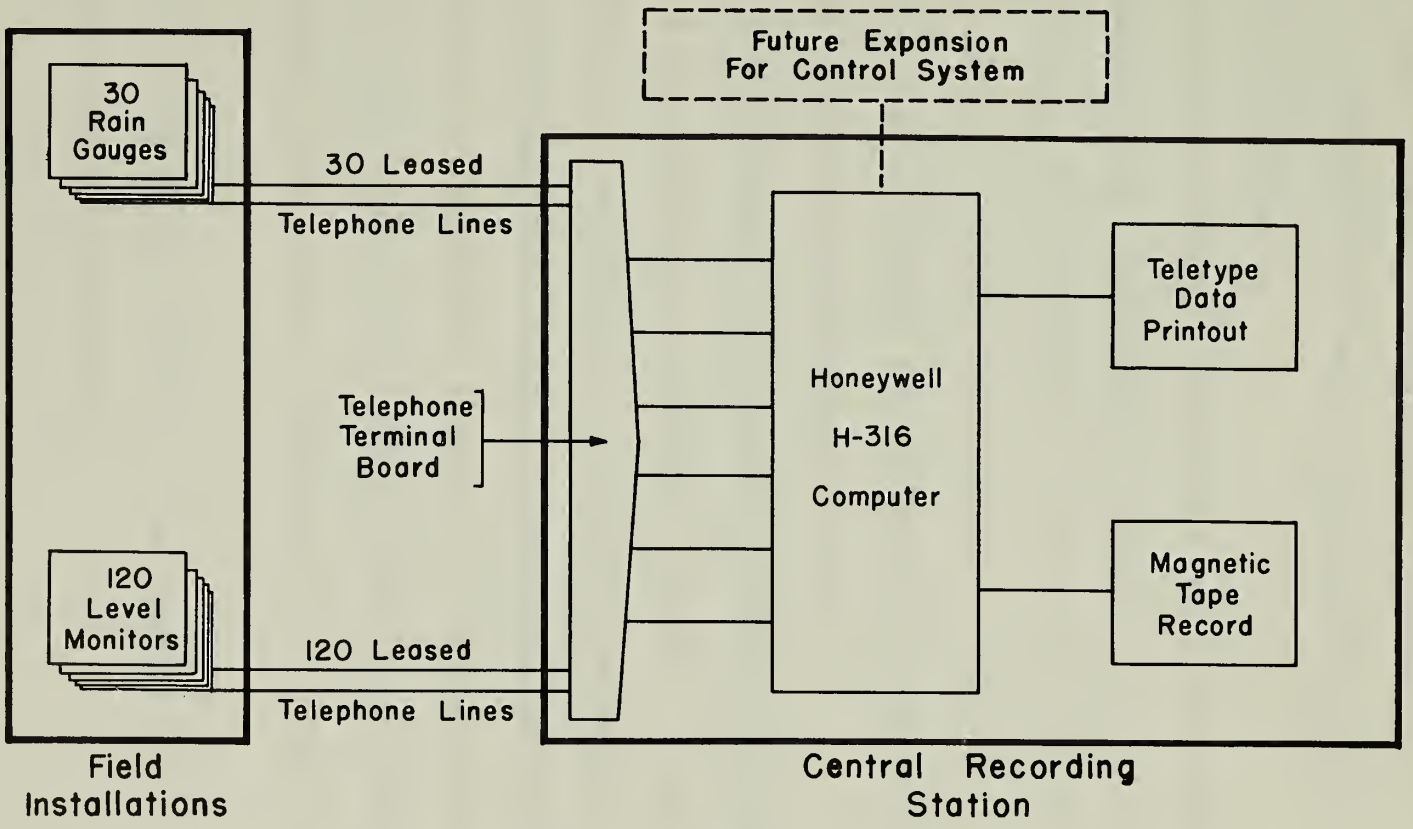
Conventional engineering analyses sizes hydraulic transport and storage facilities by the "rational" method which combines rainfall rate, drainage time, drainage area and a constant, reflecting the runoff percentage to determine the discharge rate at selected locations in a drainage system. For any given storm occurrence, the discharge rate and volume of the corresponding transport or retention facility size can be theoretically computed at various points in the system. This approach is based on the assumption that the runoff percentage (coefficient), and rainfall is uniform over an entire area. Small variations in these two "assumptions" can affect the sizes of a wet weather control system and thus the estimated costs by a significant amount. The City recognized this and initiated two programs to develop reliable rainfall-runoff relationships for the design of a wet weather overflow control system. It was also recognized that there would be need to develop a means of optimizing (combining and balancing) the various possible solutions for wet weather control. Toward these ends, the

City, in 1969, initiated a rainfall network which now consists of 30 tipping bucket rain gauges throughout the City, (approximately one rain gauge per 1-1/2 square miles). Augmenting the rainfall gauges was a companion network of flow measuring devices located at critical points in the sewerage system. The network consists of 120 flow stations located at existing outfalls and points upstream.

This information collected is telemetered to a small computer which is capable of producing raw data records, five-minute summary records and one-hour summary records depicting the status of the system at any given time. This system is schematically shown on Plate VIII-1.

The information describes the specific rainfall-runoff relationships of major drainage and sub-drainage areas and will be utilized to provide the basis for the final design of the selected Alternate Master Plan. Ultimately, the data collected by this system, together with various control devices, will be used to manage the sewerage system during rainfall occurrences.

A history of the last 62 years of U.S. Weather Bureau records for the single first order rain gauge in the City was used with a computer program developed to simulate various



San Francisco Hydrologic And
Hydraulic Data Acquisition System
BLOCK DIAGRAM

PLATE VIII-1

control combinations of storage and treatment. Applying a run-off coefficient to the analyses and assuming uniform rainfall over the City yielded the basic facility sizes used in the Master Plan development.

Data collected to date indicates that the assumption of uniform rainfall over the City is conservative thus, the feasibility of the use of the smaller sized facilities for alternates A and B. Further data must be collected to refine the facility design sizes and to develop the operational procedures necessary to make the proposed control system viable.

In conjunction with the data collection, the operating procedures and possible design problems inherent in retention facilities needs to be investigated in a real application. Therefore, the final development of design and operating procedures for storage facilities should be preceded by the construction of one retention facility in the first stage of the Master Plan for a prototype evaluation. This would serve the following purposes:

1) Check the effectiveness of the separation structure for floatable and solids removal;

2) Confirm the minimum predicted maintenance requirements of the retention facility;

3) Provide the basis for pre-programmed operational procedures;

4) Demonstrate the feasibility of unmanned remote computer control of the system in-so-far as possible.

A mathematical model of San Francisco's sewer system has been developed to simulate the response of the sewerage system to rainfall topography land use, and tidal change. The model will be used in an attempt to depict hydraulic flows and accompanying constituent transport through the elements of the sewer system. As yet, the model is incomplete and has not been verified with data obtained from the sewer system.

Satisfactory continuous verification of the model to provide the ability to predict other data will necessitate making a variety of flow and constituents measurements at specific locations followed by subsequent tuning of the model to the measured data. At least one full year of data will be required prior to any real predictive use of the model.

The most important aspect of the model is its use in predicting the response of the City's sewerage system to a variety

of possible changes such as land use changes, population shifts and flow re-routing which will be encountered in the phased construction of the facilities proposed in the Master Plan. With the projected results of such changes, design modifications can be incorporated into the initial facility design to effect long-term systems cost savings.

SECTION IX

ENVIRONMENTAL EFFECT OF WASTE DISCHARGE TO THE BAY AND OCEAN

The prime consideration in the development of acceptable solutions for the disposal of treated waste from the City was the establishment of reasonable assurance that there would be no adverse effect to the marine life or to any existing or contemplated beneficial use of the Bay and Ocean.

In order to develop such assurance the City engaged a "blue ribbon" Technical Advisory Board consisting of Dr. P. H. McGauhey, Professor Emeritus of Sanitary Engineering of the University of California, as Chairman, Dr. C. L. Newcombe, Professor of Biology of San Francisco State College, Dr. W. North, Professor of Environmental Health Engineering of the California Institute of Technology and Dr. P. Wilde, Professor of Oceanography of the University of California. The function of this Board was to provide technical guidance to the firm of Brown and Caldwell which was engaged by the City to perform the field, laboratory and evaluation work on the Bay and Ocean. This work was required to develop the oceanographic and biological design criteria necessary for evaluation and selection of waste discharge locations.

In addition, the City established a Project Advisory Board, consisting of representatives of the State Department of Fish and Game, State Department of Public Health, State Water Resources Control Board, Regional Water Quality Control Board, U.S. Army Corps of Engineers, Environmental Protection Agency, and Marin County and San Mateo Counties to review the results of this study and to develop guidelines that would insure the success of the study and its acceptance by these various agencies. The study was also strengthened by obtaining the services of Dr. George Schuman, Marine Biologist of Marine Associates of San Diego who performed laboratory work in San Diego concurrent with that work performed in the Marine Laboratory at Fort Baker under the supervision of Dr. Newcombe.

The field and laboratory work performed by Brown and Caldwell and the evaluation of that work is described in general in the Comprehensive Report and described in full detail in References Nos. 4 and 24. The work performed by Dr. North and Dr. Schuman is described in detail in Reference Nos. 7 and 25 respectively.

The studies of the condition of the bay and ocean with regard to the ultimate disposal of both treated dry weather and wet weather wastes from San Francisco were conducted over a full year cycle of oceanographic conditions. Measurements included both physical and ecological parameters under field

and laboratory conditions, as noted above, for the purpose of developing design criteria for effluent disposal. As a result of this effort, criteria for discharge have been developed which reflect existing oceanographic conditions and which can be transposed to reflect future conditions.

Briefly, the factors governing the design, location and successful performance of submarine outfall discharges may be divided into three classifications: oceanographic, ecological and physical. Oceanographic design criteria include those physical oceanographic factors such as currents and water density which influence the performance of an outfall. Ecological design criteria define the conditions which the discharge must meet to avoid an adverse effect on the marine environment. Physical design criteria refer to factors such as waste composition and flow rate, and the characteristics of the outfall system. In essence the physical criteria are those which may be manipulated while the oceanographic and ecological criteria are design constants.

Oceanographic Design Criteria

As a result of intensive field measurements over one full year, followed by detailed evaluation of all the gathered data, oceanographic design criteria for discharges to the Gulf of the Farallones and to the Central Bay were developed. For

dry weather discharges to both the Central Bay and to the Gulf of the Farallones the fall season represents the most severe constraints upon the design criteria, and for wet weather discharges the winter season represents the design condition.

For these conditions, the oceanographic criteria which apply to discharges to the Gulf of the Farallones may be summarized as follows:

1. To keep the effluent underwater at all times, (a submerged field) the discharge must be located outside the bar in 80 feet or more of water.

2. An effluent field that rises to the surface and is released at any point inside the bar in a water depth greater than about 60 feet will be transported seaward by the prevailing currents.

3. Effluent discharged through a properly designed diffuser located west of the mouth of the Golden Gate will have no measurable effect on the Bay.

4. Any dry weather discharge within the Gulf of the Farallones should be located at least one mile offshore.

5. A wet weather discharge might suitably be made less than one mile offshore near the mouth of the Golden Gate in an area where the effluent field would be carried along with westward-moving surface water mass.

Oceanographic criteria which apply to discharges to the

Central Bay may be summarized as follows:

1. Net surface water movement in the Central Bay is seaward at all times of the year.

2. Surface water movement in the bay south of the Bay Bridge, between the bridge and Hunter's Point, is much weaker than in the Central Bay, but still is seaward at most times and locations.

3. Surface drift of floatables released in the mid-Central Bay is seaward at all seasons. No significant deposition will occur along the Bay shoreline, and the distribution along the ocean shoreline will be approximately the same as for an ocean release.

4. With a high dilution outfall, an effluent field can be maintained beneath the water surface most of the time. Exceptions will occur in summer and fall when the effluent field will surface.

Ecological Design Criteria

A number of water quality objectives have been set forth by the control agencies to prevent adverse ecological effects from marine waste discharges. The results of the field and laboratory investigations over the last two years, together with the results of similar investigations by others, have been used to develop design criteria for use in planning for waste discharges in a manner which will avoid adverse

ecological effects consistent with the water quality objectives of the regulatory agencies.

It is noteworthy that most test animals showed no adverse response except at very low dilutions of effluent. The lowest dilutions that had a negative response were 50:1 and 100:1. In each instance the most sensitive animal tested has been used in the development of the ecological criteria. Two of the most sensitive organisms were the larvae of the market crab and the bay shrimp. All criteria are based on the assumption that future discharges will be equivalent in toxicity to the present dry weather chlorinated primary effluent. In translating the results of field and laboratory tests into the design criteria listed below, a factor of safety of 10 has been employed. Safety factors will obviously increase as higher treatment levels are provided. If the following criteria are met there will be no adverse ecological impact from San Francisco's waste effluent.

1. Where possible, effluent dilutions along the shoreline or in the shallow water (less than 10 feet deep) should not be less than 1000 to 1 for more than 24 hours at a time.

2. Egg carrying market crabs appear to be vulnerable to the effects of exposure to high concentrations of sewage effluent. The bottom zones, in areas where these crabs are

present, should not receive sustained exposure to effluent in dilutions less than 500 to 1.

3. Plankton and fish populations should not be exposed to effluent dilutions of less than 100 to 1 for more than 24 hours or less than 200 to 1 for prolonged periods of exposure.

4. Deposition of sewage solids on the ocean floor should be minimized.

5. From the standpoint of protecting the marine eco-system in the Gulf of the Farallones, a surface effluent field is preferable to a submerged field for two reasons:

a. A surface field will be transported away from intertidal areas.

b. A surface field provides the greatest factor of safety for protection of the bottom dwelling animals.

6. Since rocky intertidal areas have a greater diversity of animals and productivity than sandy beaches, a preferred location for an outfall in the Gulf of the Farallones would lie south of a line extended westward along the centerline of the Golden Gate. The sandy beaches to the south are not productive clamming areas and are not likely to have to be protected for the taking of shellfish.

These criteria can then be translated for each area of potential discharge around the periphery of the City.

It was concluded that the best long-term discharge location for the City's wet weather flow was in the Gulf of the Farallones south of the bar. This area and the north of the bar location also represent the best location for total dry weather flow disposal. The North Point Plant dry weather flow and some wet weather flow may also be disposed of in the Central Bay without any adverse ecological effect under present Delta flow and total discharge conditions. Total assimilative capacity of the area is physically limited by the total available tidal and Delta flows however, and anticipated relocation of other major waste discharges to the Central Bay coupled with the projected reduced Delta flows may decrease the desirability of this location for long-term discharge without subsequent upgrading of effluent quality by all dischargers to the Central Bay. The area south of the Bay Bridge is the least desirable location for continued discharge.

SECTION X-A

DRY WEATHER SOLUTION - IMPROVEMENT TO EFFLUENT QUALITY

In order to determine a correlation between cost and levels of improvements to the existing treatment plants, the City engaged the firm of Brown and Caldwell, Consulting Engineers, to analyze the existing plants and to make recommendations to meet anticipated requirements with particular emphasis towards the capability of meeting the future high quality effluent requirements that can be expected from inferences in the Regional Board's Interim Basin Plan. The results of the study are described in the Comprehensive Master Plan Report and in the reports prepared by Brown and Caldwell, References 18, 19, 20, 21, 22, and 23.

Briefly, the reports indicate that based on four design parameters, (turbidity, floatables, grease and settleable matter) the degree of increased effluent quality desired is proportional to the cost of necessary plant operational improvements and additional treatment facilities. The initial work recommended at each of the plants was complete renovation of all primary treatment process equipment and selected plant modifications to upgrade operation to provide optimum primary treatment efficiencies as defined in Section IV. Many of the initial plant

improvements would also be necessary to attain the maximum benefit of any advanced treatment processes required for the higher removal levels investigated. Each plant was studied individually and recommendations for advanced treatment were made after consideration of present plant operation, raw sewage characteristics, land available for plant expansion and anticipating future discharge restrictions.

Processes investigated ranged from modifications for optimizing the existing primary process, as mentioned above, to providing the capability of producing a waste water effluent suitable for all reclamation uses with the possible exception of domestic supply through direct recycling.

The range of various process levels is described by the three levels shown on Plate VI-11. There are other intermediate levels which can be attained by substituting other processes such as biological methods for those shown. However, for both the requirements that exist today and for those contemplated, the three levels represent the possible stages of development that can be anticipated and that are practical.

Existing requirements can be met with first level treatment, which is the City's immediate dry weather program objective. Requirements that are presently being developed by the Regional Board possibly may require second level treatment. It is also possible that first level treatment together with a viable

DEFINITIONS AND EFFICIENCIES OF TREATMENT LEVELS

Levels of Treatment	Survival in Undiluted Waste Stream	BOD Removal (%)	Nitrogen Removal (%)	Phosphate Removal (%)	Suspended Solids Removal (%)	Grease in Effluent (mg/l)	May Be Accomplished By
I. First Level Treatment (1)	25	40	15	50	75	25	Chemical Treatment using a low Ferric Chloride dosage.
II. Second Level Treatment (2)	40	70	20	85	88	15	Chemical Treatment using a high Lime dosage.
III. Third Level Treatment (3) & (4)	90	94	85	93	98	10	Chemical Treatment utilizing a high Lime dosage treatment **followed by Reclamation Treatment**

Notes:

1) Equivalent removal efficiency described as Advanced Primary Treatment in Bay-Delta Report
2) Equivalent removal efficiency described as Intermediate Treatment in Bay-Delta Report
3) Equivalent removal efficiency described as Tertiary Treatment in Bay-Delta Report
4) The proposed reclamation treatment for Dry Weather flow would consist of the following additional unit processes: Super Chlorination, Dual Media Filtration and Carbon Adsorption.

PLATE VI-11

industrial wastes program would satisfy some of the new requirements forthcoming in the near future. Long range objectives of the regulatory agencies may require third level treatment for some if not all of the projected dry weather flow. If the new Federal requirements are applied to the City's discharges in order to qualify for Federal and State grant funding, then third level treatment for all dry weather discharges to Bay will be necessary in the near future and waivers will have to be obtained for dry weather discharges to the ocean and for all wet weather discharges.

Present City programs are based upon existing requirements and past policy. Obviously if requirements and policy are changed as drastically as presently indicated, then much of the present program would have to change. Lack of definitive information from the regulatory agencies (State and Federal) at this time prevents the development of a single definitive Pollution Control Master for dry weather. Therefore, a series of alternatives have been incorporated into the Master Plan with sufficient flexibility to allow decisions to be made as new requirements become known.

Plate VI-12 shows the costs attributable to the dry weather program in millions of dollars escalated to 1974 levels to be consistent with the Master Plan costs. Also shown are the cost

FIRST COST COMPARISON OF EXPANDING 3 EXISTING PLANTS vs. 1 NEW PLANT

	TYPE OF TREATMENT	TREATMENT RATE - MGD				COST MILLIONS		
		R-S	SE	NP	LM	Dry Wea.	Wet Wea.	Total
A. EQUIVALENT LEVELS - ALL PLANTS	I. First Level Treatment							
	a)	70	70	200	660	$ 42	$105	$147
	b)	x	70	200	730	41	103	144
	c)	x	x	200	800	40	101	141
	d)	x	x	x	1000	42	107	149
	II. Second Level Treatment							
	a)	70	70	200	660	66	104	171
	b)	x	70	200	730	69	103	172
	c)	x	x	200	800	73	101	174
	d)	x	x	x	1000	83	107	190
	III. Third Level Treatment							
	a)	70	70	200	660	168	105	273
	b)	x	70	200	730	161	103	264
	c)	x	x	200	800	144	101	245
	d)	x	x	x	1000	130	107	237
B. VARIABLE LEVELS	I. Second Level Treatment at NP, and Ocean Discharge; Third Level at SE							
	a)	70	70	200	660	93	105	198
	b)	x	70	200	730	95	103	199
	c)	x	x	200	800	73	101	174
	d)	x	x	x	1000	83	107	190
	II. Second Level Ocean Discharge; Third Level NP & SE							
	a)	70	70	200	660	147	105	252
	b)	x	70	200	730	150	103	253
	c)	x	x	200	800	127	101	228
	d)	x	x	x	1000	83	107	190

x - Abandoned Wea. - Weather

portions of the total treatment facilities attributable to wet weather based upon flow and the total treatment system costs.

The cost related to treating wet weather flow is included in this table for each treatment scheme because the existing plants must meet the same requirements during both wet and dry weather and the total treatment costs are the most illustrative of the treatment options. All possible combinations of various discharge requirements are incorporated in the cost matrix. Since wet weather and dry weather solutions are interrelated, these total costs are additive to the other wet weather facility costs to provide a total Master Plan treatment and control program cost. A description of the wet weather costs is contained in Sections XI and XII and the costs on Plate VI-12 are only for treatment facilities. Costs for the other wet weather facilities are contained in Section XII. Not included on Plate VI-12 are the operation and maintenance costs associated with the various levels of treatment. Annual operation and maintenance costs for the three levels at the existing plants have been developed and are detailed in References 20, 21, 22, and 23. The ratios of the treatment costs for each treatment level to existing operation and maintenance costs are as follows:

Level of Treatment	Operational Cost Ratio New Level to Existing Costs
First	2:1
Second	3:1
Third	5:1

These ratios represent the estimated maintenance and operational costs for the (a) row of the matrix on Plate VI-12. It is anticipated that these would be reduced somewhat with plant consolidation.

SECTION X-B

DRY WEATHER SOLUTION - INDUSTRIAL WASTE SOURCE CONTROL

There is no greater concern relating to the adverse effects of waste discharges on marine life than the concerns relative to waste toxicity, both long-term and immediate. The emphasis on toxicity control, as expressed by the State Department of Fish and Game and the Federal Bureau of Sport Fisheries to and through the Regional Water Quality Control Board, is an indication that this water quality parameter is of primary importance. The present techniques for the measurement of waste toxicity are crude because of the wide range of results obtainable. Test results are indicative of reaction to wastes but do not identify the causes of the reaction. Toxicity can be immediate or acute in nature, resulting in instantaneous kills of aquatic life, or it can be long-term or chronic which results in a buildup of toxic substances in marine life over a period of years with an accompanying slow and subtle adverse effect.

The Comprehensive Report records the effect of heavy metals

and pesticides emanating from the effluent from the three treatment plants. From field work performed by Brown and Caldwell (Reference No. 18) and an industrial waste survey performed by URS (Reference No. 6) conducted in the southeast area of the City, it was concluded that the heavy metals and pesticides as well as other industrial waste constituents discharged to the City's sewer system do constitute a major contribution towards violating effluent toxicity requirements. Toxicity, whether caused by heavy metals or pesticides discharge or by other chemical constituents, singularly, or in combination, creates a treatment problem that can not be satisfactorily solved with first or second level treatment. To obtain a consistently high level of removal of toxicants requires a degree of treatment which approaches that required for reclamation. Source control represents a more feasible approach to the control of many toxicants. The possible effects of rigid source control can be illustrated by considering the amounts of heavy metals that may be possible to remove from the existing influent to the treatment plants. An evaluation of this situation indicates that industrial contributions range from 32% of the aluminum present to 90% of the lead and 96% of the mercury.

It was for this purpose that in December 1970 the City passed one of the most rigid industrial waste ordinances in the country together with a supplemental appropriation to provide the funding necessary to initiate the program. The industrial waste ordinance categorizes waste into three categories: those which were specifically prohibited; those which are allowed subject to specific limiting values, which include toxicity, pH and dissolved sulfides; and those which are permissible but subject to a fee when the concentration exceeds that which would be expected from normal domestic sewage. This ordinance provides for the establishment of an Industrial Waste Review Board to set policies relative to industrial waste discharges, and to perform as a board of appeal from actions of the Department of Public Works. The ordinance grants the Director of Public Works the authority to plug a side sewer or to terminate water service to an industry in the event that the industry does not comply with requirements by the Department of Public Works. Given a viable industrial waste program, adequate treatment, and proper effluent dispersion, the solution for prevention of adverse toxic effects to the marine life can be attained.

SECTION XI

WET WEATHER SOLUTIONS

Treatment Plant Rate versus Storage Capacity

The wet weather pollution problems, as distinguished from the dry weather pollution problems previously discussed, occur only during or immediately following rainfall over the City when the City's combined system overflows a mixture of raw sewage and stormwater to the Bay or Ocean without any treatment. As was noted in Section VI, these overflows contribute a significant amount of material which impairs the aesthetic quality of the bay and ocean and causes the waters to exceed Public Health standards for water contact sports such as swimming and wading.

In evaluating the possible solutions to the problem there are four possible ways of approaching the problem:

1) Separate the City's system. This is too costly, would result in great inconvenience to the individual business and property owner; and would not solve all pollution problems

associated with pollution from wet weather runoff.

2) Provide enough treatment to treat all overflows up to some selected design overflow frequency; Evaluation of this option indicates that to provide enough treatment to contain overflows in the range of 8 or 4 untreated overflows per year would be too costly and would be impractical from an operational point of view;

3) Provide sufficient storage to control overflows up to some selected rainfall design occurrence; This was investigated and was also found to be too costly when using only the existing available treatment capacity, thus the last approach;

4) Provide a combination of storage and increased treatment capacity to limit uncontrolled overflows to a design frequency; This approach provides the optimum conditions for control of the City's system and is the basis for the Master Plan solution presented. Schematically this is represented on Plate VI-9, page IX-3.

Treatment Plant Rate versus Storage Capacity

The hydraulic capacity needed to treat the total existing sewer system design storm runoff, which occurs once in five years, would be at a rate of 25,000 cubic feet per second or about 16,000 million gallons per day. This is approximately 50 times greater than the combined capacity of the three

PLATE VI-9

SCHEMATIC DIAGRAM OF WET WEATHER CONTROL

existing treatment plants.

By providing storage the necessary treatment capacity can be reduced. Study of the costs and the practical nature of the problem of controlling overflows has resulted in a practical range of control of from 8 untreated overflows per year to 1 untreated overflow in 5 years with 4 overflows per year and one overflow per year as intermediate points. This can be compared to the existing total number of annual overflows of 82. Control within this overflow frequency range is from 90% control with 8 overflows per year to 99+% control with 1 overflow every five years. These frequencies and control factors are based upon an analysis of the past 62 years of rainfall records which were available on tape for computer analysis. The overflow frequencies of 8, 4, one time per year, and once in five years are referred to as Alternates A, B, C, and D respectively.

It was concluded that the proper design balance point is to provide a maximum of 1,000 million gallons per day of treatment capacity and 9, 16, 34, and 55 million cubic feet of storage for Alternates A, B, C, and D, respectively. The discussion of how to obtain the required 1,000 million gallons per day rate is discussed commencing on Page XI-12. The means of providing storage facilities is as follows:

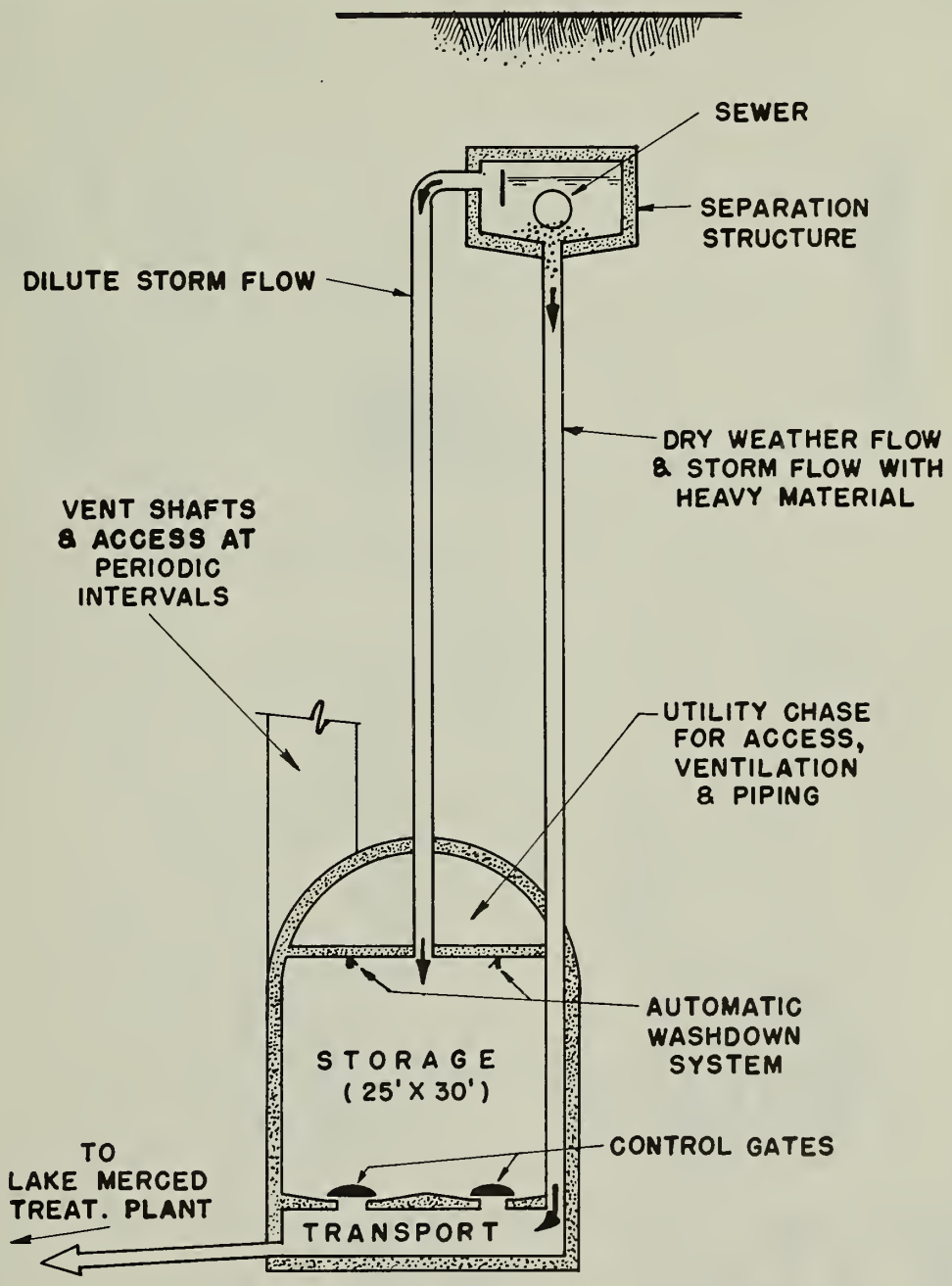
Tunnels:

Depending on location, tunnels are practical in providing required storage. They are constructed entirely below ground, thus eliminating much surface disruption of traffic, damage to property, and minimizing dust and nuisance. They can be bored in one operation in diameters up to thirty-five feet, and are capable of both storage and transport. Bechtel Inc. and Mr. A.D. Parker, heavy construction consultant, were retained to evaluate the feasibility and costs of the use of tunnels.

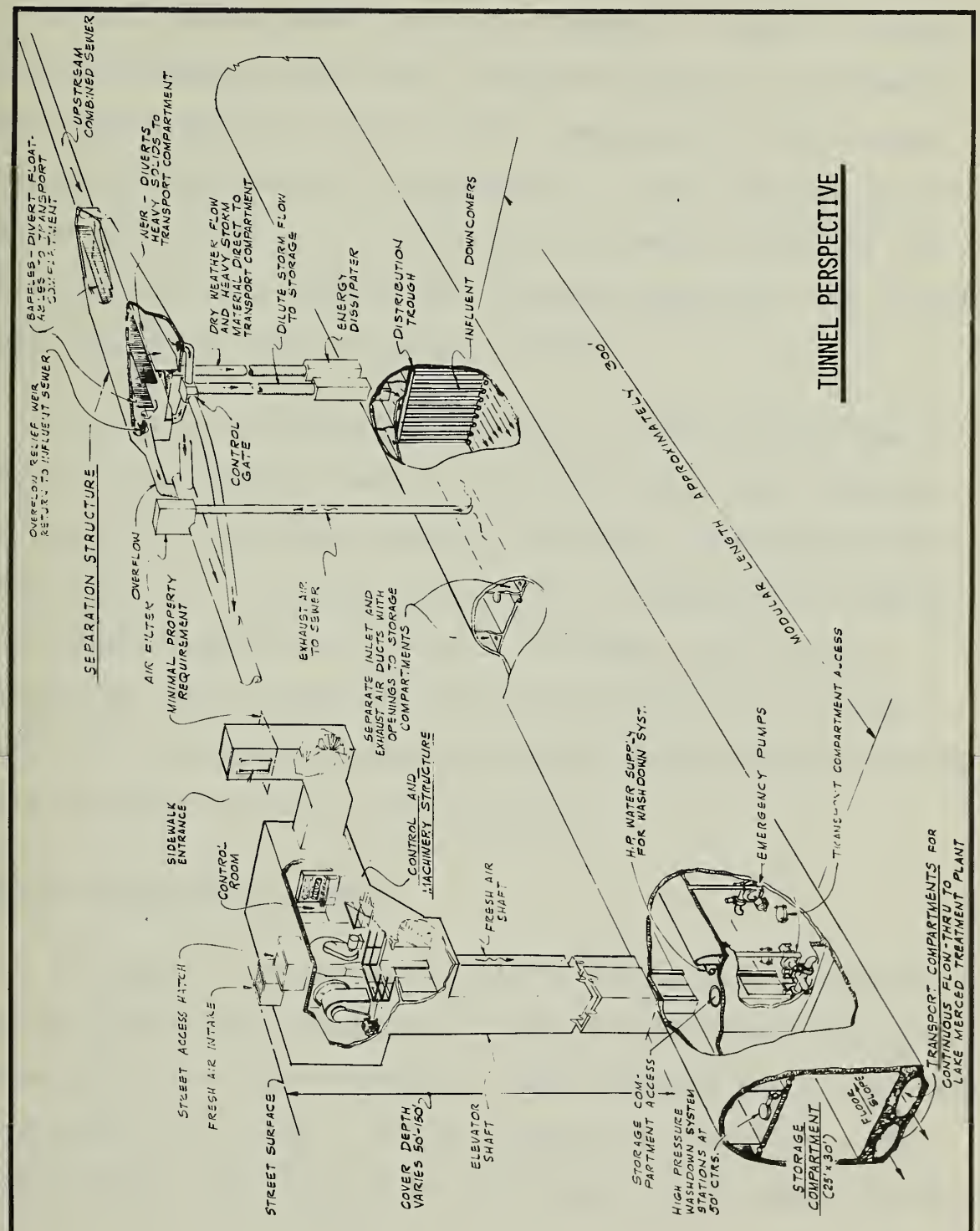
Costs of tunnels are affected by soil type and geologic conditions. Low level (deep) tunnels, while generally less expensive, require pumping to remove stored waste water and are difficult to clean.

Higher tunnels, along selected alignments, lessen the disadvantages associated with deep tunnels because of gravity draining capabilities and reduced maintenance.

Plate VI-8, page XI-6, shows a schematic section and Plate XI-7, page XI-7, shows a perspective view of a typical high tunnel. The tunnel incorporates a lower section for waste water transport to treatment with the objective of keeping the solid material moving to the treatment plants. At the top of the tunnel section a utility duct is provided for


SEWER
SEPARATION STRUCTURE
DILUTE STORM FLOW
DRY WEATHER FLOW & STORM FLOW WITH HEAVY MATERIAL
VENT SHAFTS & ACCESS AT PERIODIC INTERVALS
UTILITY CHASE FOR ACCESS, VENTILATION & PIPING
AUTOMATIC WASHDOWN SYSTEM
STORAGE (25' X 30')
CONTROL GATES
TO LAKE MERCED TREAT. PLANT
TRANSPORT

SCHEMATIC SECTION OF TUNNEL


TUNNEL PERSPECTIVE
SEPARATION STRUCTURE
BAFFLES - DIVERT FLOATABLES TO TRANSPORT COMPARTMENT
UPSTREAM COMBINED SEWER
OVERFLOW RELIEF WEIR RETURNS TO INFLUENT SEWER
WEIR - DIVERTS HEAVY SOLIDS TO TRANSPORT COMPARTMENT
DRY WEATHER FLOW AND HEAVY STORM MATERIAL DIRECT TO TRANSPORT COMPARTMENT
DILUTE STORM FLOW TO STORAGE
ENERGY DISSIPATER
DISTRIBUTION TROUGH
INFLUENT DOWNCOMERS
CONTROL GATE
OVERFLOW
AIR OUTLET
MINIMAL PROPERTY REQUIREMENT
EXHAUST AIR TO SEWER
SEPARATE INLET AND EXHAUST AIR DUCTS WITH OPENINGS TO STORAGE COMPARTMENTS
CONTROL AND MACHINERY STRUCTURE
SIDEWALK ENTRANCE
CONTROL ROOM
FRESH AIR SHAFT
H.P. WATER SUPPLY FOR WASHDOWN SYST.
EMERGENCY PUMPS
TRANSPORT COMPARTMENT ACCESS
APPROXIMATELY 600' MODULAR LENGTH
STREET ACCESS HATCH
FRESH AIR INTAKE
STREET SURFACE
COVER DEPTH VARIES 50-150'
ELEVATOR SHAFT
STORAGE COMPARTMENT ACCESS
HIGH PRESSURE WASHDOWN SYSTEM STATIONS AT 30' CTRS.
STORAGE COMPARTMENT (25' x 30')
FLOOR
FLOOR
TRANSPORT COMPARTMENTS FOR CONTINUOUS FLOW-THRU TO LAKE MERCED TREATMENT PLANT

ventilation and piping. Ventilation will be in the form of a forced air system, with fresh air brought in from the surface and then exhausted back into the sewer system. An automatic wash down system will carry solids remaining in the storage tunnels to the transport compartment to the treatment plants. Separation structures in line with the sewers and above the tunnels remove the heavier and floatable materials and inhibit them from going into the storage tunnel.

Visits by maintenance personnel to check on performance should be no oftener than once per month with some cleaning of the portion of tunnel used for storage, occurring possibly once per year. Emergency pumps will be installed to dewater the storage facilities in case of blockage. All of the facilities will be underground, and the only visible signs will be by fresh air intakes and street access, hatches which will be flush with the street surface.

Shoreline Retention Basins

Storage at the shoreline will be provided by retention basins rather than tunnels due to the possible cost savings. These will be at the terminus of sewer systems and are storage structures just below or at the surface of the street. The construction conditions at the shoreline are extremely difficult

because of soil and water conditions, and the sizes of these basins must be kept to a minimum. They will be segregated into chambers which permit the use of only part of the storage basin as required.

Preceding the storage chamber is a separation structure which, through a system of weirs, segregates the heavier material and the floatable material which is dispatched on to the treatment plant; the relatively dilute material is routed to storage through a system of down spouts to the bottom of the tanks to aid in cleaning the tanks. As a storm subsides, the stored material is pumped back into the separating chamber to wash the material remaining and the total volume is transported to the treatment plant. A positive fresh air ventilating system is also incorporated. A high pressure wash down system with directional operating nozzles will clean the retention basins between storms. The supply for this wash down system could be from ground water, if available, or from the domestic water supply system.

Maintenance will be accomplished by automating the cleaning procedures as much as possible. However, the pumps and the ventilation system will require a periodic maintenance visit approximately twice a year, with major overhauls at approximately 5 years, and replacements at 15 years.

The decks of these shoreline retention basins offer the opportunity for multi-purpose use, such as for recreation, parks, and for Port facilities. This would in part offset the impact and cost of the required land acquisition and higher costs for the construction of these basins as compared to inland basins.

Inland Retention Basins

At upstream locations along the sewer system, storage will be provided by inland retention basins, where geologic conditions make tunneling more expensive. This situation predominates in the western half of the City. Inland retention basins are similar in many respects to shoreline basins with some minor differences. The dry weather flow, rather than being diverted upstream of the basin, is routed around the retention basin and rejoins the sewer downstream of the basin. The separation structure performs the same function as described above, that is, to minimize the entrance of solids into the storage facility.

Some advantages of the upstream structures are that provision of storage ahead of sections of the sewer system which are "inadequate" are made adequate by delaying the passage of upstream runoff through this section of sewer and the inherent ability to flush lower basins along the system with material retained in upper basins. Plate VI-10, page XI-11, shows a

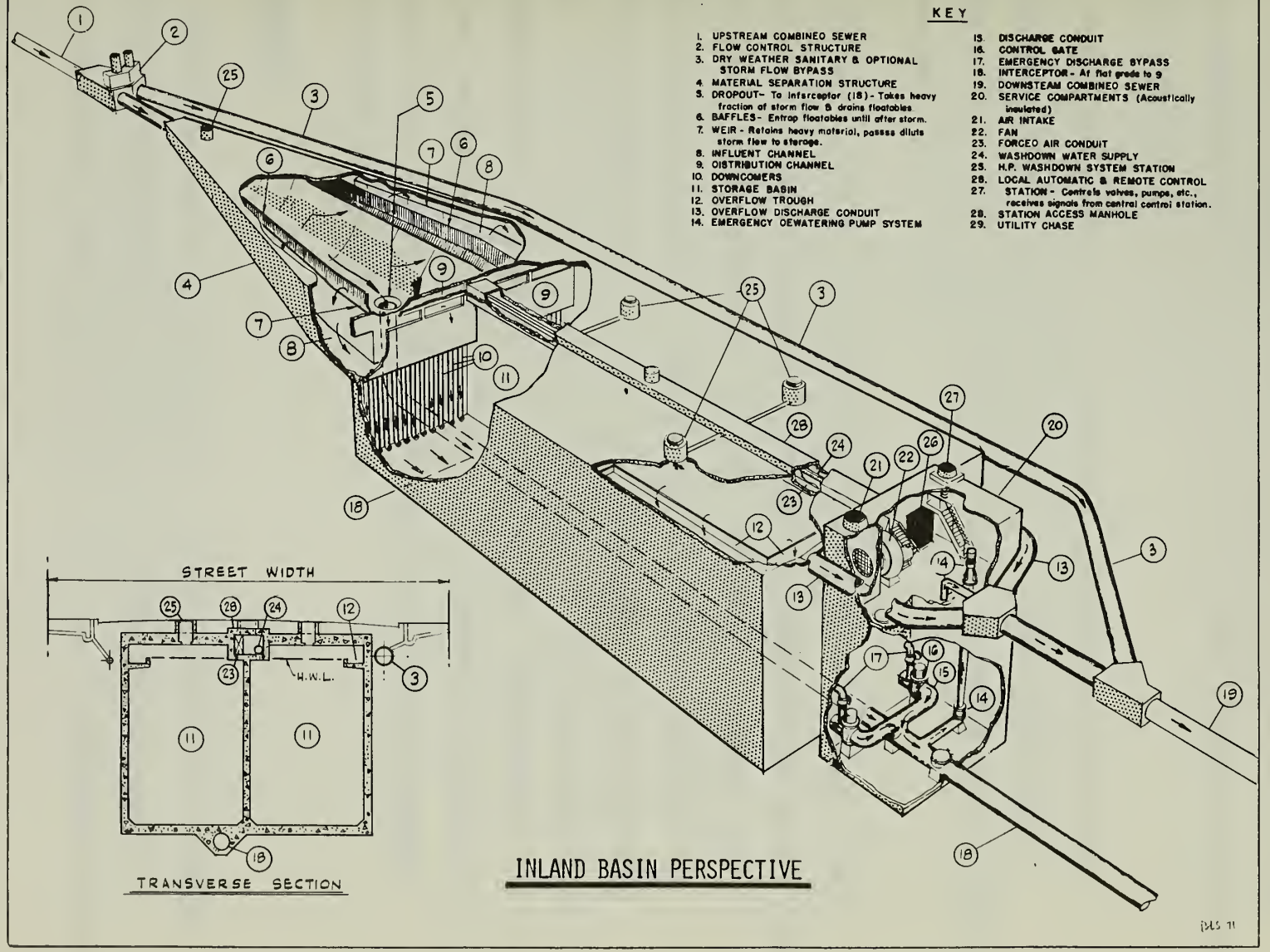

KEY
1. UPSTREAM COMBINED SEWER
2. FLOW CONTROL STRUCTURE
3. DRY WEATHER SANITARY & OPTIONAL STORM FLOW BYPASS
4. MATERIAL SEPARATION STRUCTURE
5. DROPOUT- To Interceptor (18)- Takes heavy fraction of storm flow & drains floatables
6. BAFFLES- Entrap floatables until after storm.
7. WEIR - Retains heavy material, passes dilute storm flow to storage.
8. INFLUENT CHANNEL
9. DISTRIBUTION CHANNEL
10. DOWNCOMERS
11. STORAGE BASIN
12. OVERFLOW TROUGH
13. OVERFLOW DISCHARGE CONDUIT
14. EMERGENCY DEWATERING PUMP SYSTEM
15. DISCHARGE CONDUIT
16. CONTROL GATE
17. EMERGENCY DISCHARGE BYPASS
18. INTERCEPTOR - At flat grade to 9
19. DOWNSTEAM COMBINED SEWER
20. SERVICE COMPARTMENTS (Acoustically insulated)
21. AIR INTAKE
22. FAN
23. FORCED AIR CONDUIT
24. WASHDOWN WATER SUPPLY
25. H.P. WASHDOWN SYSTEM STATION
26. LOCAL AUTOMATIC & REMOTE CONTROL
27. STATION - Controls valves, pumps, etc., receives signals from central control station.
28. STATION ACCESS MANHOLE
29. UTILITY CHASE
STREET WIDTH
H.W.L.
TRANSVERSE SECTION
INLAND BASIN PERSPECTIVE

PLATE VI-10

typical upstream basin. The operation of this upstream basin will be via a remotely controlled series of valves which will allow variation of the drainage rate from these basins depending upon the character of a storm.

These basins will be constructed in City streets thus eliminating costly land acquisition. In sizes less than a million cubic feet these basins are less expensive than tunnels of the same total volume.

Similar features for maintenance and operation are incorporated in the inland retention basins as exist in the shoreline facilities. The difference is that the pumps provided are merely standby pumps for dewatering the storage facility in case of blockages, and for use in wash down of the retention basin. Thus, the maintenance requirements for the pumps will be less than for shoreline retention basin. Maintenance visits will be required during the wet weather season to check on the status of the retention basin and once a year some cleaning will probably be required.

Treatment:

Discussion up to this point has revolved about the general hydraulic considerations involved in containing the massive flows resultant from storm flow into the City's combined system.

Historical rainfall data was extensively used to evaluate the combinations of storage and treatment rate required to reduce uncontrolled overflows. These combinations were then estimated as to cost and in all cases a treatment capacity of 1000 million gallons per day was found to provide the most economic combination of storage and treatment capacity. The results of this evaluation are illustrated in the Comprehensive Report. Since the three existing treatment plants can treat only up to 340 MGD, more treatment capacity must be provided to economically control overflows and must be of sufficient degree to meet Regional Board requirements.

The Regional Board present requirements for discharge from the existing plants do not differentiate between dry weather flows and wet weather flows and all existing treatment plant discharges must meet the same requirements. Existing requirements for wet weather overflows are somewhat similar to the dry weather treatment plant discharge requirements. The differences between existing dry and wet weather discharges are that the wet weather requirements are less restrictive relative to certain constituent discharge limitations such as solids and the aesthetic parameters relative to the visual effects of overflows.

In evaluating the level of treatment that is necessary and reasonable for wet weather overflows, the intermittence of occurrence and the duration of use of the treatment facility must be considered. These conditions were evaluated for the treatment rate and storage volumes investigated. While rainfall occurs generally between September and April, the total hours that a wet weather treatment facility is operational amounts to the equivalent of only 9 to 10 full days annually. Thus, much of the time, the wet weather facility would be idle. An analysis of the total reduction of constituents provided by various levels of treatment for the continuous dry weather flows and the intermittent wet weather flows was also performed. This analysis indicated that the provision of any treatment better than first level for the wet weather flows exceeding the capacity of the dry weather facility's results in negligible reductions to annual emissions. Consideration of these two factors leads to the conclusion that disposal facilities should only provide the level of treatment and disposal necessary to alleviate the most significant adverse effects of overflows and that the control of long-term effects upon the environment should be accomplished through the treatment of the continuous dry weather flows. This means that wet

weather treatment must provide bacteriological, aesthetic protection for the nearshore waters and ecological protection against acute discharge toxicity.

These goals can be attained by primary or equivalent treatment of the wet weather flows and offshore deepwater disposal of the effluent through an outfall designed to develop a surface field which will be transported away from the shoreline. The maximum practical level of wet weather treatment is physical-chemical first level treatment. Higher levels are not feasible operationally nor would they provide any significant benefit.

The quality and character of the waters surrounding the City were described in Section IX and more fully in the Comprehensive Report. Based on studies of the receiving water surrounding San Francisco, there are only two sites recommended for the combined discharge of the massive quantities of flow under consideration: (a) the northwesterly corner of the City with an outfall extending to deep water in the channel near the entrance to the Bay, and (b) a location in the ocean off the southwesterly corner of the City outside of the bar. In this context it was determined that for any combined dry and wet

weather disposal plan, the best probable location is to the west and slightly south of the San Francisco bar. Selection of this area is based upon the following advantages: (1) the area is, biologically, relatively barren; (2) the depths selected are sufficient to provide the required dilutions for discharge with properly designed diffusers to meet the design criteria presented in Section IX; (3) the option of provision for seasonal field variation between surface fields and submerged fields is possible through the use of dual outfall and diffuser facilities; (4) the shoreline is afforded maximum protection in terms of the dilution attained and the probability of effluent fields reaching shore; (5) if further protection is required as knowledge of the effects of disposal increases, then treatment levels may be increased on a split flow basis as described in Section XII without the necessity of overcoming existing background levels of pollutants as are existent in the bay or other zone of multiple discharge; (6) the possible future impairment of the waters at the Alcatraz site caused by South Bay and North Bay discharges extending into Central Bay, would be averted.

Areas at the mouth of the Gate and near Alcatraz have some, but not all, of the advantages noted. Areas south of the Bay Bridge are less desirable than any of the above locations.

Possibilities for treatment extend from maintenance of the existing plants and providing one wet weather plant for intermittent use in each treatment plant zone to combining all treatment facilities for both wet and dry weather into one plant at the southwesterly corner of the City with subsequent discharge to the ocean. As noted in Section X there is some question over what levels of dry weather treatment will be required. In evaluating the combined problem both uniform levels of treatment and varied levels of treatment have been considered, and regardless of treatment levels it is most economical to provide treatment for all wet weather flow greater than existing plant capacity at one wet weather plant.

Further, within the accuracy of the estimates it can also be concluded that, if higher levels of treatment are required for all discharges or if bay discharges require a higher degree of treatment than ocean discharges, one plant for wet weather and dry weather chemical treatment may represent the least cost

solution to the long-range combined pollution control program of the City. Thus, on a long-term basis and in anticipation of more stringent requirements, the abandonment of existing facilities with consolidation affording higher levels of treatment may represent the least cost ultimate solution.

Treatment under the split flow approach which is schematically shown on Plate VI-20, page XII-23 assumes first level chemical treatment for both dry weather and wet weather flows. During dry weather, primary sedimentation with low level chemical addition could be followed by high level chemical addition to attain better treatment if required. During wet weather, split treatment options could be exercised allowing optimization of total removals up to providing single stage chemical treatment for all wet weather flow. As noted before it does not appear to be feasible or practical to provide more than a low level chemical treatment for wet weather flows.

All primary solids from the first level chemical treatment would be transported to the Southeast treatment plant and treated for final disposal in landfill or by any other acceptable method. Following split level treatment, the option

exists for developing a reclaimed waste water which may be used to provide irrigation and recreational water in parks and golf courses or ground water recharge in the bay area if economically feasible.

The plant would be designed to provide maximum multiple usage of area consistent with long-range recreational planning efforts. It is anticipated that by proper design side-by-side multi-purpose usage of treatment facility land area is possible. The experience in this regard at the Baker St. Facility in the Marina serves as a positive example of what can be accomplished.

Discharge of treated effluent will be through a dual outfall, with a wet weather diffuser designed to provide a surface field surface dispersion terminating about 2 miles offshore, and a dry weather outfall as discussed in Section X continuing for a total distance of 5 miles to a 90 foot depth of water. This latter outfall will terminate in a diffuser designed for maximum initial dilution. This entire system will provide for maximum protection of all beneficial water uses including minimum ecological impact with optimal flexibility for possible long-term reclamation developments.

SECTION XII-A

THE MASTER PLAN

The previous Section described the various solutions that were considered in the Comprehensive Report and the approach used to develop the Master Plan. There are other treatment techniques, mostly in the research or demonstration stage, that are being studied by cities throughout the nation and are being financed by the federal government. These include high rate microscreens, inflatable storage bags, and many others. The Master Plan recommendation for a new facility is based on the water quality objectives that must be achieved in this area. To this end the Comprehensive assumes that low dose chemical treatment will meet the existing and anticipated wet weather discharge requirements that will be imposed on San Francisco for a bay or ocean discharge.

As previously stated, the Master Plan consists of four levels of wet weather overflow control: Alternate A - an untreated overflow occurrence of 8 times a year; Alternate B - an untreated overflow occurrence of 4 times a year; Alternate C - an untreated overflow occurrence once per year; and Alternate D - an untreated overflow occurrence one in 5 years. Plate VI-15, page XII-2, tabulates the wet weather costs, excluding dry weather and inadequate sewers, for each

COMPARISON OF WET WEATHER COST VS. ACCOMPLISHMENTS

	EXIST. COND.	ALTERNATE A	B	C	D
Cost (Wet Weather) - $ Millions		$333	$396	$522	$665
Per Annun - Average					
Number of overflow occurrences	82	8	4	1	0.2[a]
% Reduction[b]		90	95	99	99+
Duration in hours	2.5	2	2	3	4
% Reduction		-	-	-	-
Total Hours	205	16	8	3	1
% Reduction		92	96	99	99+
Vol. of untreated overflow discharge (billions of gallons)	6	.8	.4	.1	.02
% Reduction		88	96	98	99+
Vol. of treated discharge (billions of gallons)	38.8	44.1	44.4	44.7	45
Days receiving H_2O exceeds bact. standards	171	40	20	5	1
% Reduction		77	88	94	99+
Suspended solids (million lbs.)	42	14.3	13.2	12.4	12.1
% Reduction		66	68	70	71
COD (millions lbs.)	126	81.2	80.9	80.6	80.5
% Reduction		35	36	36	36
Grease (millions lbs.)	10.8	3.5	3.4	3.3	3.3
% Reduction		68	69	69	69
Flotables (millions lbs.)	0.5	0.3	0.3	0.3	0.3
% Reduction		30	32	33	34
Nitrogen (millions lbs.)	10.4	9.7	9.7	9.7	9.7
% Reduction		7	7	7	7
Phosphate (millions lbs.)	5	1.4	1.4	1.4	1.4
% Reduction		71	71	71	71

[a] 0.2 equivalent to "once per 5 years" frequency.
[b] from "Existing Condition".

of these alternates versus the respective achievement or protection. It is noted that from an existing condition of 82 overflows per year occurring over a total of 205 hours, a reduction of 92% is obtained under Alternate A and over 99% for Alternate D. The improvement by reduction of various constituent parameters is tabulated and compared against the existing condition.

The Master Plan for each alternate is shown on Plates VI-1, page XII-4; VI-2, page XII-5; VI-3, page XII-6, and VI-4, page XII-7, respectively. The Master Plan is the same for all alternates and only the size of the facilities varies. It is feasible but not the most economic to provide facilities for one alternate as a sequential building block to reach a higher alternate.

The key facilities for the Master Plan consist of:

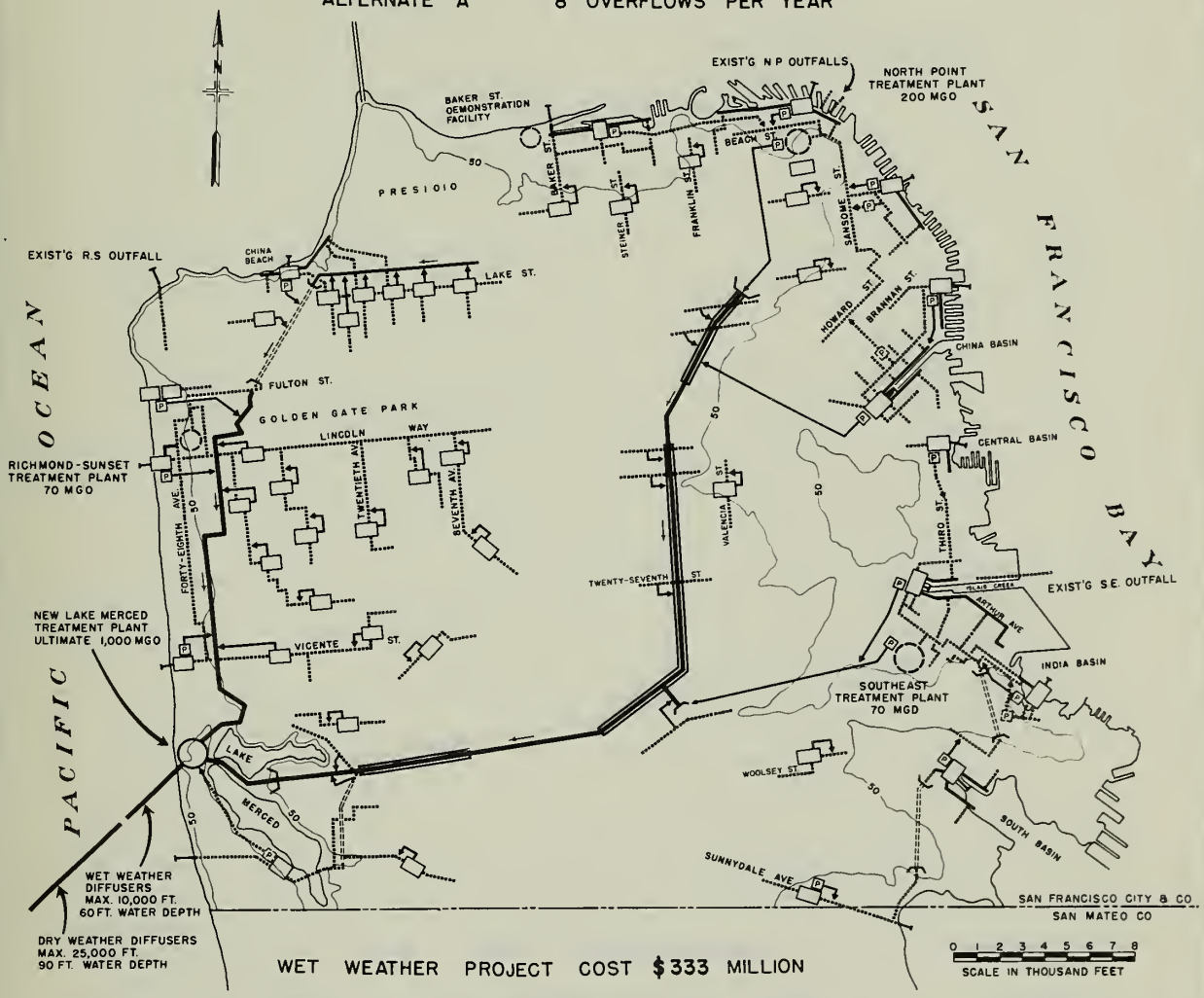
a) A new treatment plant westerly of Lake Merced and adjacent to, and southerly of Fleischhacker Zoo with an ultimate wet weather treatment capacity of 1,000 MGD. This plant is described in detail later in this Section.

b) A storage and transport tunnel which intercepts all storm drainage above the 50' elevation contour for transport to the Lake Merced area treatment plant site. The tunnel is sized to minimize the drainage runoff to the low lying area in order to reduce the size of the shoreline interception

PLATE VI-1

MASTER PLAN FOR WET WEATHER CONTROL

ALTERNATE A 8 OVERFLOWS PER YEAR



WET WEATHER PROJECT COST $333 MILLION

	NUMBER OF OVERFLOW LOCATIONS	AVERAGE NUMBER OF OVERFLOWS PER YEAR	OURATION IN HOURS	TOTAL HOURS PER YEAR	VOLUME OF † UNTREATED OVERFLOW DISCHARGE (BILLIONS OF GALLONS)			VOLUME OF † TREATED DISCHARGE (BILLIONS OF GALLONS)			DAYS RECEIVING WATERS EXCEEDS BACTERIAL STANDARDS (PER YEAR)
					OCEAN	BAY	TOTAL	OCEAN	BAY	TOTAL	
EXISTING	43	82	2.5	205	2.0	4.0	6.0	8.2	30.6	38.8	171.0
ALTERNATE A	15	8	2.0	16	0.25	0.5	0.75	44.1	NIL	44.1	40.0-80.0
% REDUCED		90%		92%	87.5%	87.5%	87.5%				53.0-76.5%

	SUSPENDED SOLIDS @ (MILLIONS OF POUNDS/YEAR)	COD @ (MILLIONS OF POUNDS/YEAR)	GREASE @ (MILLIONS OF POUNDS/YEAR)	FLOATABLES @ (MILLIONS OF POUNDS/YEAR)	NITROGEN @ (MILLIONS OF POUNDS/YEAR)	PHOSPHATE @ (MILLIONS OF POUNDS/YEAR)
EXISTING	41.7	125.6	10.8	0.47	10.4	4.75
ALTERNATE A	14.3	81.2	3.5	0.33	9.7	1.40
% REDUCED	65.5%	35.5%	68.0%	30.0%	7.0%	70.5%

† GOLDEN GATE BRIDGE-DIVIDING BOUNDARY

@ CHEMICAL SEDIMENTATION

LEGEND

DASHED LINES DENOTE EXIST'G. FACILITIES
SOLID LINES DENOTE NEW FACILITIES

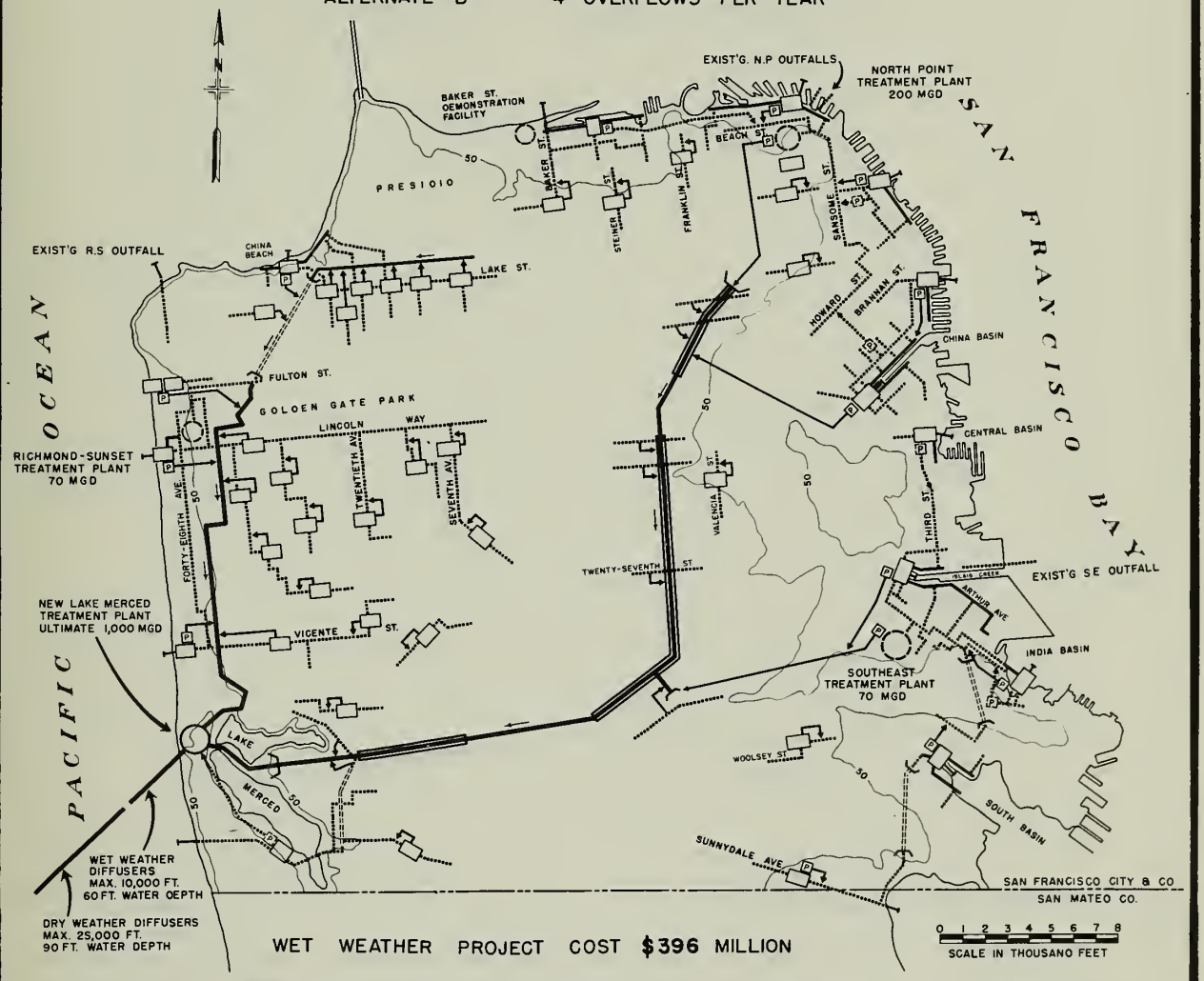
- RETENTION BASIN
- PUMP STATION
- TREATMENT PLANT
- TUNNEL
- TUNNEL WITH STORAGE SECTION
- FORCE MAIN
- SEWER
- OVERFLOW SITE
- 50 FT. CONTOUR LINE

AUGUST 24, 1971

PLATE VI-2

MASTER PLAN FOR WET WEATHER CONTROL

ALTERNATE B 4 OVERFLOWS PER YEAR



	NUMBER OF OVERFLOW LOCATIONS	AVERAGE NUMBER OF OVERFLOWS PER YEAR	DURATION IN HOURS	TOTAL HOURS PER YEAR	VOLUME OF * UNTREATED OVERFLOW DISCHARGE (BILLIONS OF GALLONS)			VOLUME OF * TREATED DISCHARGE (BILLIONS OF GALLONS)			DAYS RECEIVING WATERS EXCEEDS BACTERIAL STANDARDS (PER YEAR)
					OCEAN	BAY	TOTAL	OCEAN	BAY	TOTAL	
EXISTING	43	82	2.5	205	2.0	4.0	6.0	8.2	30.6	38.8	171.0
ALTERNATE B	15	4	2.0	8	0.12	0.24	0.36	44.4	NIL	44.4	20.0-40.0
% REDUCED		95%		96%	95.5%	95.5%	95.5%				76.5-88.5%

	SUSPENDED SOLIDS @ (MILLIONS OF POUNDS/YEAR)	COD @ (MILLIONS OF POUNDS/YEAR)	GREASE @ (MILLIONS OF POUNDS/YEAR)	FLOATABLES @ (MILLIONS OF POUNDS/YEAR)	NITROGEN @ (MILLIONS OF POUNDS/YEAR)	PHOSPHATE @ (MILLIONS OF POUNDS/YEAR)
EXISTING	41.7	125.6	10.8	0.47	10.4	4.75
ALTERNATE B	13.2	80.9	3.3	0.32	9.7	1.39
% REDUCED	68.5%	35.5%	68.5%	32.0%	7.0%	70.5%

* GOLDEN GATE BRIDGE - DIVIDING BOUNDARY

@ CHEMICAL SEDIMENTATION

LEGEND

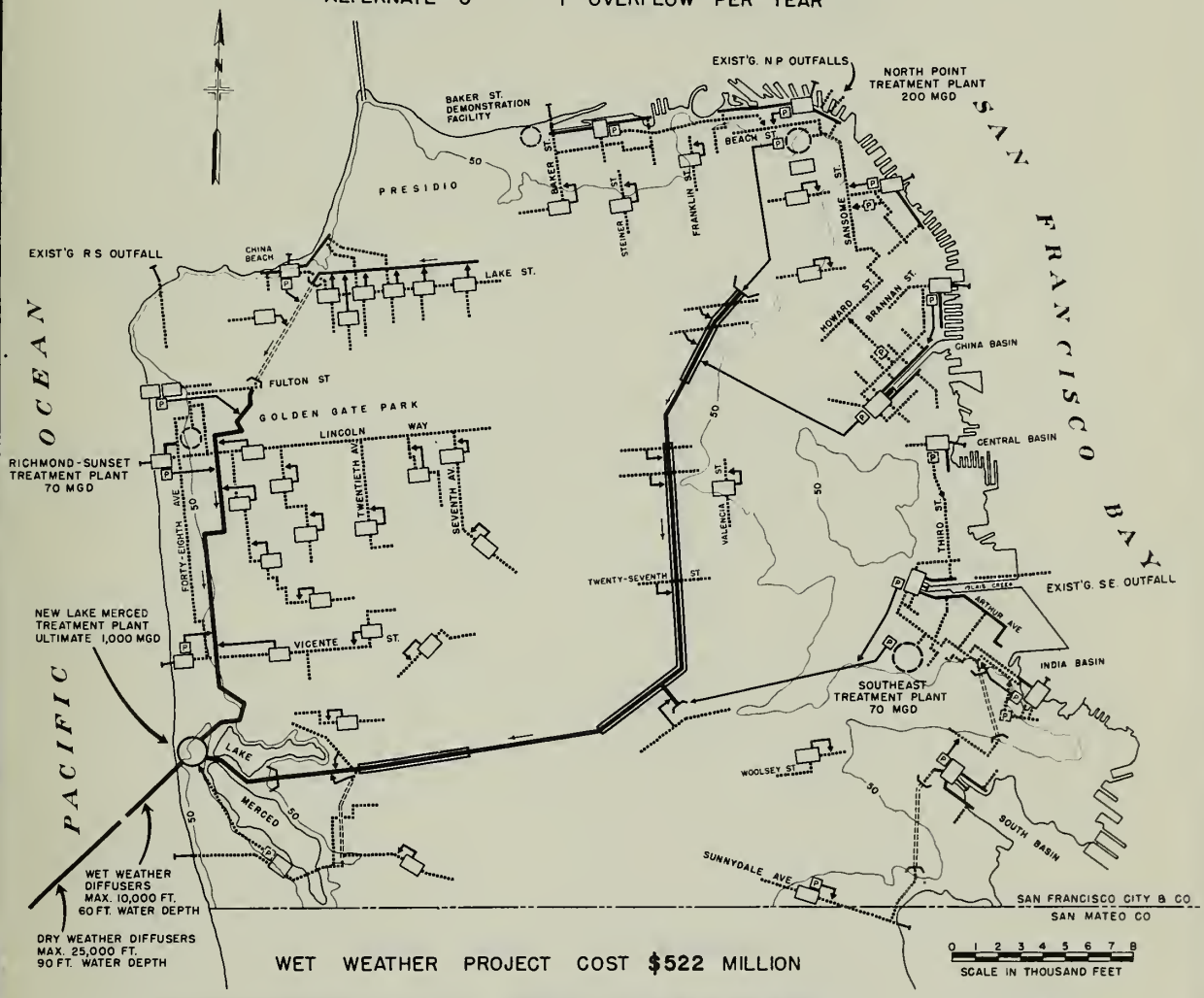
DASHED LINES DENOTE EXIST'G. FACILITIES
SOLID LINES DENOTE NEW FACILITIES

- RETENTION BASIN
- P PUMP STATION
- TREATMENT PLANT
- TUNNEL
- TUNNEL WITH STORAGE SECTION
- FORCE MAIN
- SEWER
- OVERFLOW SITE
- —50— 50 FT. CONTOUR LINE

AUGUST 24, 1971

MASTER PLAN FOR WET WEATHER CONTROL

ALTERNATE C 1 OVERFLOW PER YEAR



WET WEATHER PROJECT COST $522 MILLION

SCALE IN THOUSAND FEET: 0 1 2 3 4 5 6 7 8

	NUMBER OF OVERFLOW LOCATIONS	AVERAGE NUMBER OF OVERFLOWS PER YEAR	DURATION IN HOURS	TOTAL HOURS PER YEAR	VOLUME OF † UNTREATED OVERFLOW DISCHARGE (BILLIONS OF GALLONS)			VOLUME OF † TREATED DISCHARGE (BILLIONS OF GALLONS)			DAYS RECEIVING WATERS EXCEEDS BACTERIAL STANDARDS (PER YEAR)
					OCEAN	BAY	TOTAL	OCEAN	BAY	TOTAL	
EXISTING	43	82	2.5	205.0	2.0	4.0	6.0	8.2	30.6	38.8	171.0
ALTERNATE C	15	1	3.0	3.0	0.03	0.06	0.09	44.7	NIL	44.7	5.0-10.0
% REDUCED		99%		98.5%							97.0-94.0%

	SUSPENDED SOLIDS @ (MILLIONS OF POUNDS/YEAR)	COD @ (MILLIONS OF POUNDS/YEAR)	GREASE @ (MILLIONS OF POUNDS/YEAR)	FLOATABLES @ (MILLIONS OF POUNDS/YEAR)	NITROGEN @ (MILLIONS OF POUNDS/YEAR)	PHOSPHATE @ (MILLIONS OF POUNDS/YEAR)
EXISTING	41.7	125.6	10.8	0.47	10.4	4.75
ALTERNATE C	12.4	80.6	3.3	0.31	9.7	1.39
% REDUCED	70.5%	36.0%	69.0%	33.5%	7.0%	71.0%

† GOLDEN GATE BRIDGE-DIVIDING BOUNDARY

@ CHEMICAL SEDIMENTATION

LEGEND

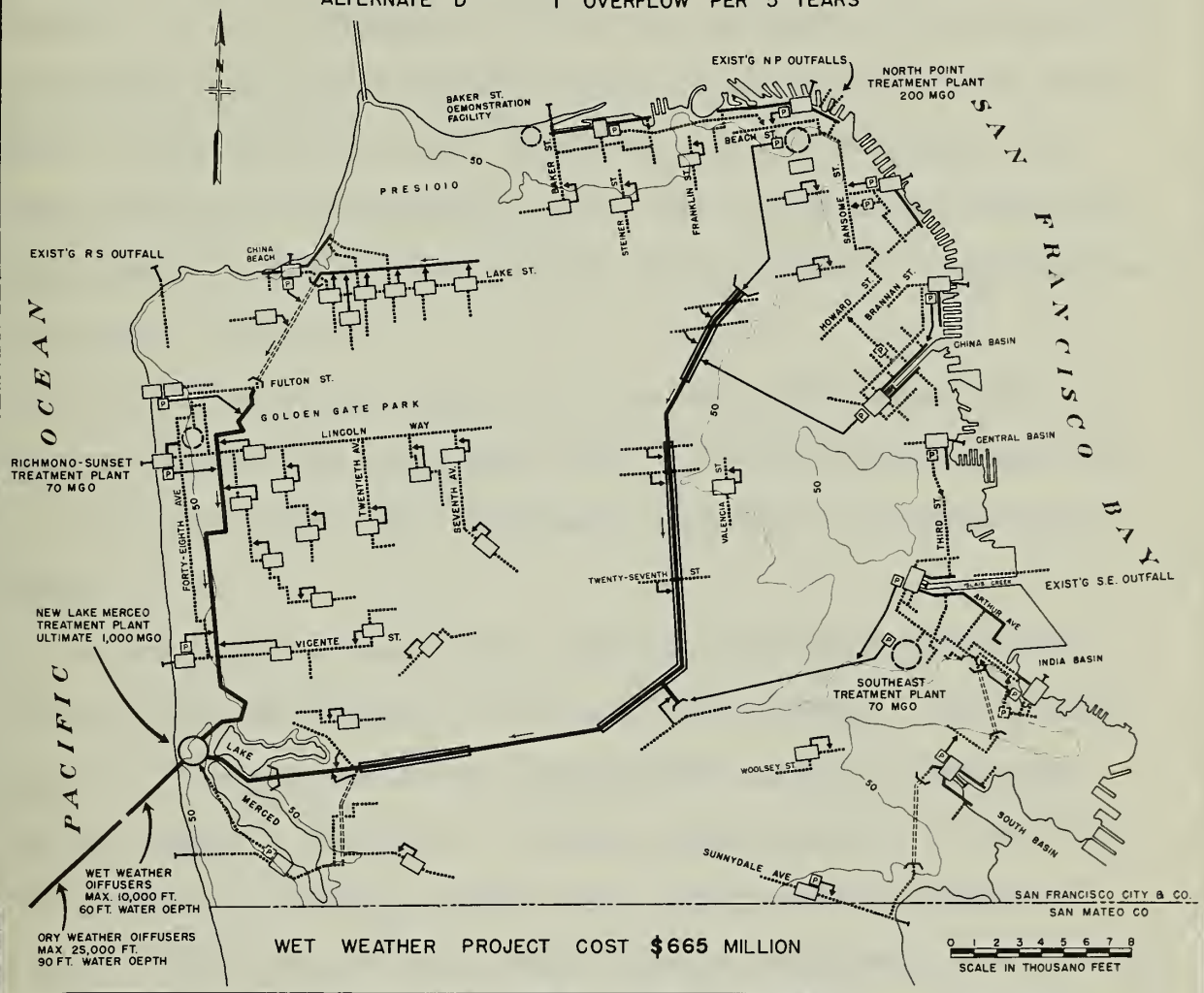
DASHED LINES DENOTE EXIST'G. FACILITIES
SOLID LINES DENOTE NEW FACILITIES

- RETENTION BASIN
- P PUMP STATION
- TREATMENT PLANT
- TUNNEL
- TUNNEL WITH STORAGE SECTION
- FORCE MAIN
- SEWER
- OVERFLOW SITE
- —50— 50 FT. CONTOUR LINE

AUGUST 24, 1971

MASTER PLAN FOR WET WEATHER CONTROL

ALTERNATE D 1 OVERFLOW PER 5 YEARS



WET WEATHER PROJECT COST $665 MILLION

SCALE IN THOUSAND FEET 0 1 2 3 4 5 6 7 8

	NUMBER OF OVERFLOW LOCATIONS	AVERAGE NUMBER OF OVERFLOWS PER YEAR	DURATION IN HOURS	TOTAL HOURS PER YEAR	VOLUME OF UNTREATED OVERFLOW DISCHARGE (BILLIONS OF GALLONS)			VOLUME OF TREATED DISCHARGE (BILLIONS OF GALLONS)			DAYS RECEIVING WATERS EXCEEDS BACTERIAL STANDARDS (PER YEAR)
					OCEAN	BAY	TOTAL	OCEAN	BAY	TOTAL	
EXISTING	43	82.0	2.5	205.0	2.0	4.0	6.0	8.2	30.6	38.8	171
ALTERNATE D	15	0.2 *	4.0	0.8 *	0.008	0.016	0.024	44.8	NIL	44.8	*
% REDUCED		100%		99.5%							

	SUSPENDED SOLIDS (MILLIONS OF POUNDS/YEAR)	COD @ (MILLIONS OF POUNDS/YEAR)	GREASE @ (MILLIONS OF POUNDS/YEAR)	FLOATABLES @ (MILLIONS OF POUNDS/YEAR)	NITROGEN @ (MILLIONS OF POUNDS/YEAR)	PHOSPHATE @ (MILLIONS OF POUNDS/YEAR)
EXISTING	41.7	125.6	10.8	0.47	10.4	4.75
ALTERNATE D	12.1 *	80.5	3.3	0.31	9.7	1.38
% REDUCED	71.0%	36.0%	69.5%	34.0%	7.0%	71.0%

* EQUIVALENT ANNUAL AVERAGE FOR 1 PER 5 YEARS OCCURRENCE (UNTREATED FRACTION)
† GOLDEN GATE BRIDGE - DIVIDING BOUNDARY
@ CHEMICAL SEDIMENTATION

LEGEND

DASHED LINES DENOTE EXIST'G. FACILITIES
SOLID LINES DENOTE NEW FACILITIES

- RETENTION BASIN
- P PUMP STATION
- TREATMENT PLANT
- TUNNEL
- TUNNEL WITH STORAGE SECTION
- FORCE MAIN
- SEWER
- OVERFLOW SITE
- —50— 50 FT. CONTOUR LINE

AUGUST 24, 1971

storage and transport facilities.

c) Shoreline retention basins are located at the head ends of China Basin, Islais Creek, and Yosemite Canal (South Basin). It is contemplated that the surfaces of the shoreline retention basins will provide open vista areas for the enjoyment of the waterfront and could be readily adaptable for water-oriented recreational uses. The China Basin retention basin would allow the re-opening of 6th Street to improve the vehicular traffic.

d) Inland retention basins are contemplated throughout the City to reduce the discharge rate to the existing sewers and to reduce the peak flow treatment rate at the proposed new plant.

e) A new dual purpose ocean outfall which will convey the effluent during periods of dry and wet weather. The outfall would be designed as a two compartment conduit dispersing the wet weather flow at a distance approximately 10,000' in 60' deep water through ports that would insure a surface field. The surface field would provide maximum protection for egg-bearing (gravid) market crabs and other bottom dwelling animals. The dry weather compartment of the new outfall would continue for a specific distance and depth depending upon whether it is disposing the effluent from 1, 2, or 3 of the existing treatment plants or from the Lake Merced area treatment plant (acting as a single dry weather plant in addition

to a wet weather plant). The ultimate length would be nearly 5 miles to a water depth of 60 to 90 feet.

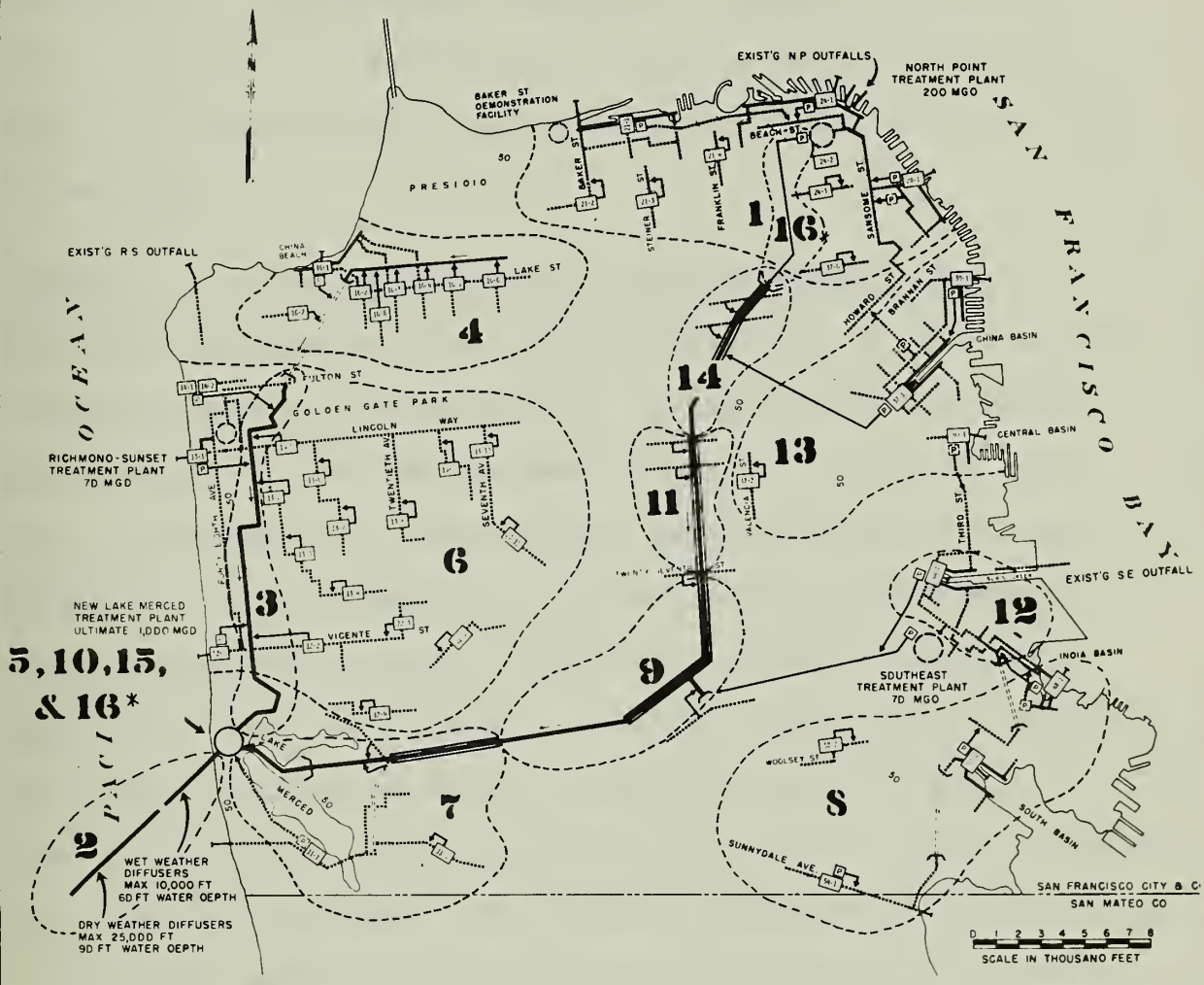
f) The remaining facilities include pumping stations intercepting conduits and force mains.

Master Plan Staging

The staging of construction for the total Master Plan consists of 16 components as shown on Plate VII-2, page XII-10, with the emphasis placed first in improving the north waterfront area, which includes Marina Beach, Yacht Harbor, and Aquatic Park, then westerly to protect Phelan, Baker, and Ocean Beach. The staging then progresses to the Candlestick-South Basin-India Basin areas as the next most likely waterfront areas that should be afforded protection from wet weather overflows. The Islais Creek central basin and China Basin areas constitute the last stages in construction because of the constraints imposed by the logical sequence in construction. However, any change in policy that would require either of those areas to be protected for wet weather overflow sooner than that indicated by its stage number could be accommodated by moving the stage to an earlier date without materially affecting the projects' costs.

Each of the sixteen stages is discussed briefly in the following paragraphs. The specific descriptions of typical

STAGE CONSTRUCTION



PROJECT COST (MILLIONS OF DOLLARS)

ALTERNATE	STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5	STAGE 6	STAGE 7	STAGE 8
A	20	30	15	12	33	27	18	20
B	27	30	15	17	33	38	20	26
C	39	30	15	28	33	67	26	40
D	53	30	15	38	33	96	32	58

ALTERNATE	STAGE 9	STAGE 10	STAGE 11	STAGE 12	STAGE 13	STAGE 14	STAGE 15	STAGE 16*	TOTAL
A	33	14	12	22	21	19	16	21	333
B	39	14	14	28	36	22	16	21	396
C	57	14	16	43	46	31	16	21	522
D	74	14	17	62	47	39	16	21	665

* STAGE 16 TO BE CONSTRUCTED ONLY IF NORTH POINT WPCP IS ABANDONED

LEGEND

DASHED LINES DENOTE EXIST'G FACILITIES
SOLID LINES DENOTE NEW FACILITIES

- RETENTION BASIN
- P PUMP STATION
- TREATMENT PLANT
- TUNNEL
- TUNNEL WITH STORAGE SECTION
- FORCE MAIN
- SEWER
- OVERFLOW SITE
- —50— 50 FT CONTOUR LINE

AUGUST 24, 1971

facilities are in Section XI and in the Comprehensive Report, together with discussions of the operational features of the structures. The sizes of the storage facilities will vary depending on the Alternate selected. Wherever possible, structures will be designed on a modular basis so that a building block approach can be used to expand the facilities if required.

STAGE 1. The Marina/North Waterfront/Financial Area. This area represents in a smaller scale most of the features characteristic of San Francisco. Starting with the Marina yacht harbor and moving eastward along the shoreline, the land use ranges from recreational areas in the Marina and Aquatic Park, to commercial fishing in Fisherman's Wharf, through waterfront usage in the piers along the northern waterfront down to the Ferry Building. There are 10 outfalls existing in this area which overflow during wet weather. This area of the City enjoys top priority in any attempt to control wet weather overflows. Thus Stage 1 consists of constructing 3 shoreline retention basins, one at the Marina Green area at the foot of Pierce Street; the second at the termination of Beach Street on the Embarcadero and the third at the termination of Jackson Street along the Embarcadero. The construction will be generally underground with little or no evidence at the surface of the existence of the facility

except for minimal required service structures. In all cases multi-use of these surfaces will be developed as intensely as possible.

In addition to these shoreline retention basins, upstream retention basins are proposed at Lombard and Franklin, and Baker and Union under Alternate A with the addition of upstream retention basins at Pacific and Stockton, and Steiner and Green Streets in Alternates B, C, & D, and one at Columbus and Union under Alternates C and D. The existing Baker Street Demonstration Facility and outfall would be utilized to handle some of the flow from this zone.

STAGE 2. Lake Merced Area Wet Weather Outfall - The area of the southwest section of the City is a favorable disposal point for treated effluent. Therefore, the construction of the outfall, which includes the disposal of the effluent from Richmond-Sunset, also provides the alternative of including the disposal of effluent from both the North Point and Southeast Plants. It would also serve to dispose of dry weather effluent from the proposed Lake Merced Plant at a possible later stage. The outfall line would be designed as a two-compartment conduit for the first section to convey both the wet weather discharges and dry weather discharges. Design would be as previously described.

STAGE 3. Ocean Beach Transport System - The construction of a tunnel between Fulton Street and the Lake Merced combined outfall area provides the first link in ultimately transferring wet weather flows to the Lake Merced treatment plant site. This will also be the primary transfer conduit for all of the retention facilities in the Sunset and Parkside areas. This conduit is a prerequisite to the construction proposed in Stages 4 and 5.

STAGE 4. Richmond District/Lobos Creek Retention Basins. A shoreline retention facility is proposed in the Sea Cliff/ Baker's Beach area which will consolidate the existing four outfalls in that vicinity into one overflow outfall. A series of 5 retention basins are proposed along Lake Street, one at California Street and 28th Avenue and another at Geary Street and 23rd Avenue to provide upstream inland retention.

STAGE 5. Lake Merced Area Water Pollution Control Plant - This is the first phase of construction of the Lake Merced Plant, and it is proposed that the initial wet weather capacity be 325 MGD. This capacity would provide the required treatment rate for the whole of Richmond-Sunset sector of the City. Upon completion of this facility, the westerly portion of the City would meet the selected overflow rate. At this point, the option also exists to make the Lake Merced facility a combined wet and dry weather plant which would allow the

phasing out of the Richmond-Sunset Treatment Plant, thereby releasing to park use the several acres now occupied by that plant.

The Lake Merced plant would be operated as a combined dry weather-wet weather split flow treatment plant as shown on Plate VI-20, page XII-23. The Plot Plan, and the Perspective View of the proposed plant are shown on Plate VI-21, page XII-24 and Plate VI-23, page XII-25. Proposed outfall discharge locations are shown on Plate VI-25, page XII-26.

Multi-use of the plant area would be made to provide parking facilities for the Zoo, vista points and recreational areas. Nearly the entire 40 acre site could, through proper planning, be made usable for many multi-use purposes for the public. The property for the Lake Merced treatment plant, as shown on Plate VI-21, consists of occupying mostly City property under the Recreation and Park Commission's jurisdiction and property owned by the State of California and U.S. Government. No property on the tax roll is required.

The Lake Merced treatment plant site was selected because of the need for large land area. It is directly offshore of one of the most favorable outfall disposal sites as evaluated by the Brown and Caldwell oceanographic and outfall study (Reference No. 24). Further, it provides the advantage of being beneficially located to receive the discharges from

San Mateo County if such proves desirable.

STAGE 6. Richmond-Sunset Retention Facilities. In this phase, three shoreline retention basins, at Vicente Avenue, Lincoln Way and Fulton Street, and from eight to fifteen inland retention basins, depending on the Alternate selected, will be constructed. The topography in this area slopes generally from the central hill mass to the ocean, and is ideally suited for the construction of inland retention structures. The basins are placed so as to relieve the sewers downstream from being overloaded during heavy downpours, and flooding should be relieved considerably in this area at the completion of this plan.

STAGE 7. Lake Merced Tunnel and Retention Basins. The Lake Merced Storage Tunnel serves the dual function of providing upstream storage capability for this area, and as the final leg of the central storage and transport tunnel to be completed in Stages 8, 11 and 14.

Retention basins are also proposed, at Brotherhood Way and Thomas More Drive. A second retention basin is proposed in the vicinity of the existing Lake Merced Pumping Station on John Muir Drive.

With the completion of Stage 7, the northerly and westerly sections of San Francisco will be brought up to the wet weather control levels projected in the four Alternates. At this

point the Southeast Water Pollution Control Plant may also be phased out if dry weather facilities are made available at the Lake Merced Plant.

STAGE 8. Candlestick Retention Basin.- In the future plans for this area an intensification of recreational and residential development is projected. Therefore, this area is of first priority for wet weather control after the completion of the western side. A shoreline retention basin is planned for Sunnydale Avenue. A second shoreline retention basin is proposed at Yosemite in the South Basin area. There are 3 outfalls in this vicinity which will consolidate as part of this stage. The location of this basin in a planned light industrial area is suitable for a multi-use development of this surface area for structures for an industrial park. Another possible use is an incorporation of park areas on the surface to allow viewing and recreation in this area. An inland retention basin is proposed at the vicinity of Sommerset and Wayland.

STAGE 9. Tunnel Storage for South Basin in Candlestick. In Stage 9 another link of the Central Tunnel will be constructed. This section of the tunnel has a dual purpose of storing runoff for this area conveying flows to the Lake Merced Water Pollution Control Plant. It will connect with the tunnel constructed in Stage 7 at Junipero Serra and Lyndhurst.

STAGE 10. Expansion of Lake Merced Water Pollution Control Plant to 550 MGD Capacity. The expansion of the Lake Merced facility at this stage will result in the reduction of overflows to the levels projected in the various alternates for the Candlestick-South Basin-Bayshore area.

STAGE 11. The Central District Storage and Transport Tunnel. The third segment of the Central Tunnel will be constructed in this phase, and will extend from Duboce and Fillmore to the vicinity of 27th Street and Sanchez, where it will connect to the tunnel constructed in Stage 9. The completion of this phase will,to a great extent, direct the upstream runoff from the area draining to China Basin. The dry weather flow from this area may also be diverted to the Lake Merced Plant if facilities are provided.

STAGE 12. Islais Creek Shoreline Retention Basin and Related Sewers. A shoreline retention basin will be constructed in this stage in the vicinity of the head of Islais Creek. The top of the retention basin will be at the surface, and thus there could be dual use of this surface for Port activities, or for development of park and recreational facilities. At present there are six outfalls draining into or near Islais Creek which will be consolidated in this stage. The Port of San Francisco plans extensive LASH facilities in the Creek, and careful planning and close coordination between the Port

and the Department of Public Works, with the participation of City Planning, should result in a well integrated development for this area. The viewing of maritime activity is one possible use that can be accommodated from the surface of this basin.

A smaller basin is planned for the India Basin area which will consolidate the three existing outfalls in that area. This facility can be integrated into the planned recreational area, and small boat harbor and marina, providing pedestrian access to the shoreline.

Included in this stage will be the construction of a force main to deliver flows up to the Central Tunnel for conveyance to the Lake Merced facility.

STAGE 13. China Basin Retention Facilities. At the head of the Channel which terminates in China Basin, is the outfall for the Division Street sewer, a major sewer system. A large shoreline retention facility is necessary to control wet weather overflows at this point. As in the case of the Islais Creek retention basin, multi-use possibilities exist in terms of integration with planned small boat docking facilities, park and viewing area, and the reopening of 6th Street across the channel. Seven existing outfalls presently discharging into the channel will be consolidated.

Another shoreline retention facility is planned in the Central Basin area at the end of Mariposa Street.

STAGE 14. Central Storage and Transport Tunnel, North Section. The construction of this tunnel will complete the storage and transport central tunnel which provides the capability of transferring all flows from bay discharge to ocean discharge. The tunnel will begin at the section of Larkin and Eddy Streets and end at the intersection of Duboce and Fillmore Streets. This stage completes all of the storage facilities construction for the Master Plan, and provides all the required transport facilities to the Lake Merced Water Pollution Control Plant for treatment and discharge into the ocean, except for the delivery conduit from the North Point Water Pollution Control Plant to the tunnel facilities.

STAGE 15 (& STAGE 16). Expansion of Lake Merced Treatment Plant. The Plant would be expanded to 820 MGD to accommodate the Stage 14 drainage area and provides the capability of treating all flows presently being handled by the Richmond-Sunset and the Southeast Water Pollution Control Plants. The completion of this phase in combination with the hydraulic capacity at the North Point Water Pollution Control Plant will result in the control levels projected under the various Alternates. If the North Point Water Pollution Control Plant is to be phased out, then an additional Stage 16 is necessary to transfer the treatment capacity from North Point to Lake Merced, making the latter a 1000 MGD facility.

The Lake Merced Treatment Plant is staged in three definite stages - for capacities of 325 MGD, 550 MGD, and 820 MGD respectively, and an ultimate flow of 1000 MGD. This last stage of treatment plant expansion to 1000 MGD assumes that the North Point Treatment Plant effluent will be prohibited by State requirements from being discharged into San Francisco Bay as a long term solution, and that the City would be ineligible for federal grants if the North Point treatment plant does not produce an effluent which meets the 85% BOD removal regulation. If such an eventuality did occur, the sequence of Stage 16 could be accelerated by deferring the implementation of Stages 8, 12, and 13.

Implementation of Dry Weather Program

There are several factors and unresolved questions that affect the implementation of the Dry Weather Program as it relates to the implementation of the Wet Weather Program. These are:

1) There is a 1970 City commitment to the Regional Board to complete by July 1973 all necessary projects to bring the sewage treatment plants into compliance with the requirements existing at that time;

2) There are pending new and more restrictive requirements anticipated in 1971 for the North Point plant and

similar requirements will probably be prescribed in 1971 for the Richmond-Sunset plant, and in the next few years for the Southeast plant;

3) There is an existing EPA regulation for grant eligibility relative to 85% BOD removal, and uncertainty whether a waiver of that regulation can be obtained for the North Point Treatment Plant;

4) The Wet Weather Transport System envisaged in the Master Plan would not be completed for probably a 30-year period, and thus that system would not be available until that time for transport of the effluent or raw sewage from the three treatment plants;

5) It is very difficult to staff or operate a treatment plant for wet weather only due to the intermittent nature of the rain and runoff. Assuming that 4 years are required to design and construct the Lake Merced Plant, the phasing out of the Richmond-Sunset plant, which is the most logical plant to be consolidated, could not be accomplished until the completion of Stage 5;

6) The consolidation of the treatment plants as a long-range objective with corresponding efficiencies in staffing

and operation is a desirable direction to follow;

7) If the treatment level increases from a low dose chemical (level 1) to a high quality (level 3), there is a large and disproportionate site area requirement which is not consistent with the value of land usage in Golden Gate Park (Richmond-Sunset Plant) or the Northern Waterfront (North Point Plant). Upgrading the treatment of the dry weather flow at those two plants to third level quality would require that either the plants be phased out or that the effluent from the plants be given subsequent treatment at the Lake Merced plant.

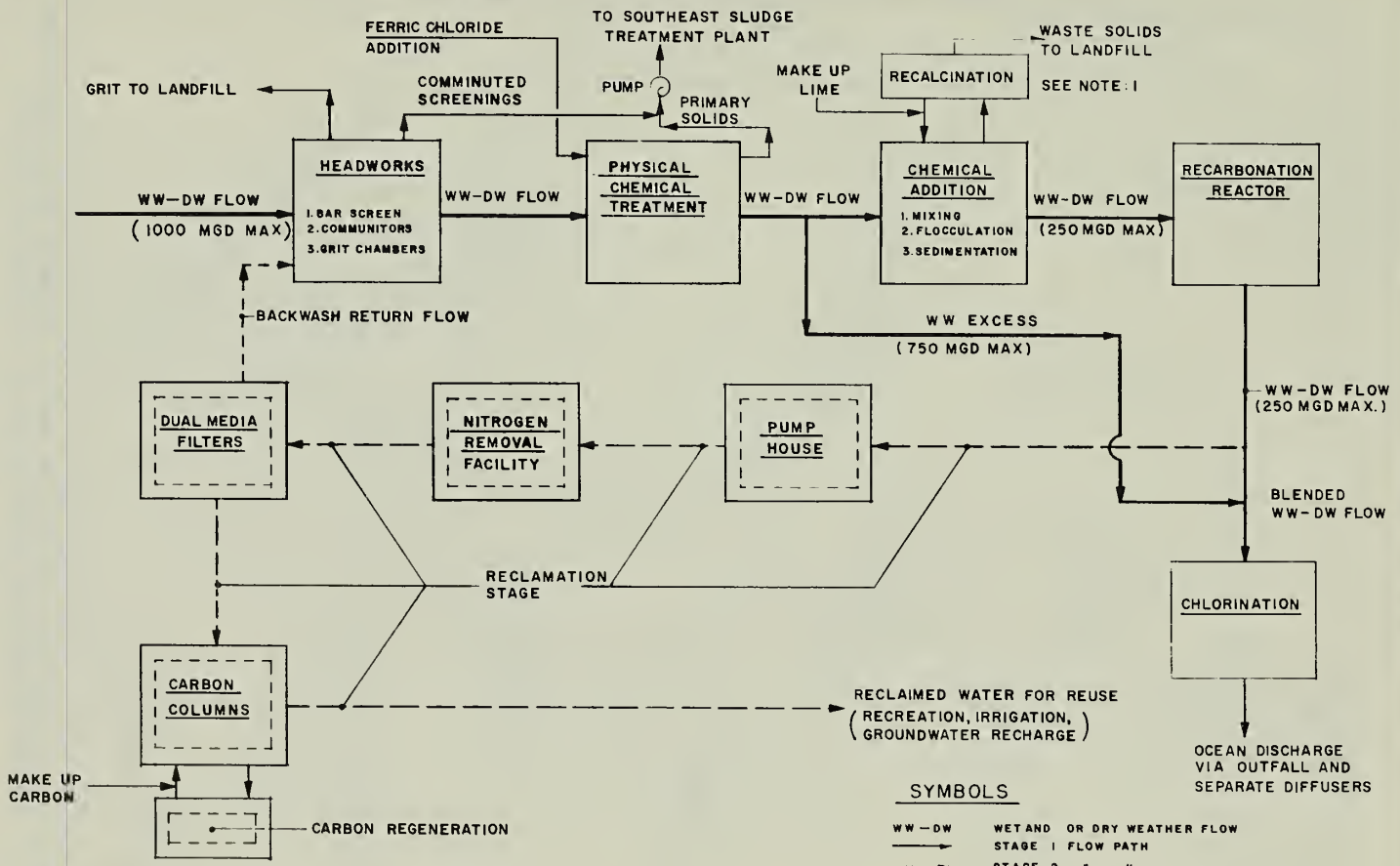
8) The prohibition of Bay discharges for the Southeast plant appears inevitable in the long-range planning of the Regional Board.

Further long-range policy indicates that the discharge of reclaimable waste waters is considered to an interim means of disposal until feasible projects for reuse are developed. Thus portions of the present discharges may also be incorporated into reclamation projects.

This dilemma of direction due to these factors is categorized and characterized as Schemes I, II, III, on Plate VI-14, page XII-27.

PROPOSED LAKE MERCED WATER POLLUTION CONTROL PLANT

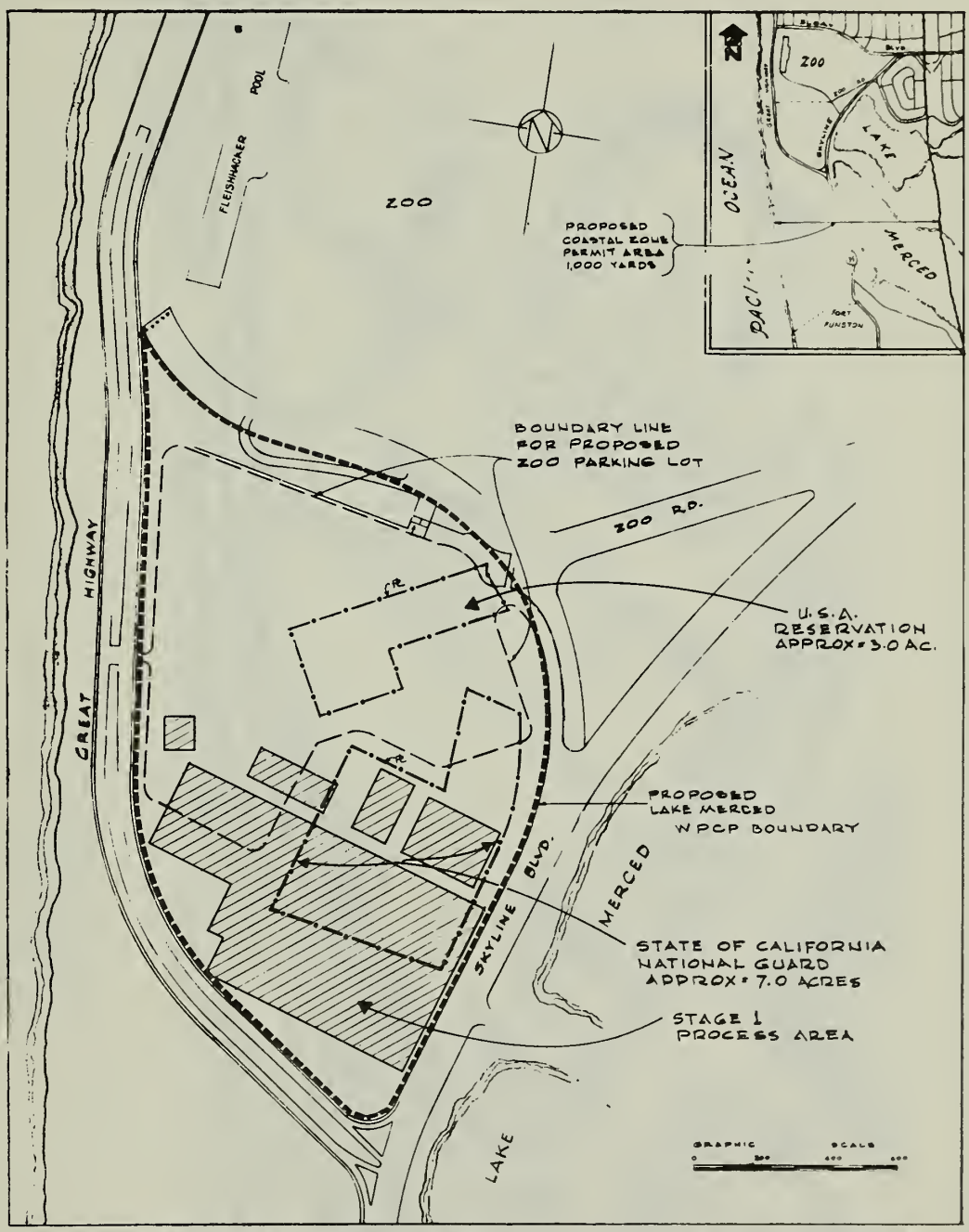
CONCEPTUAL FLOW DIAGRAM



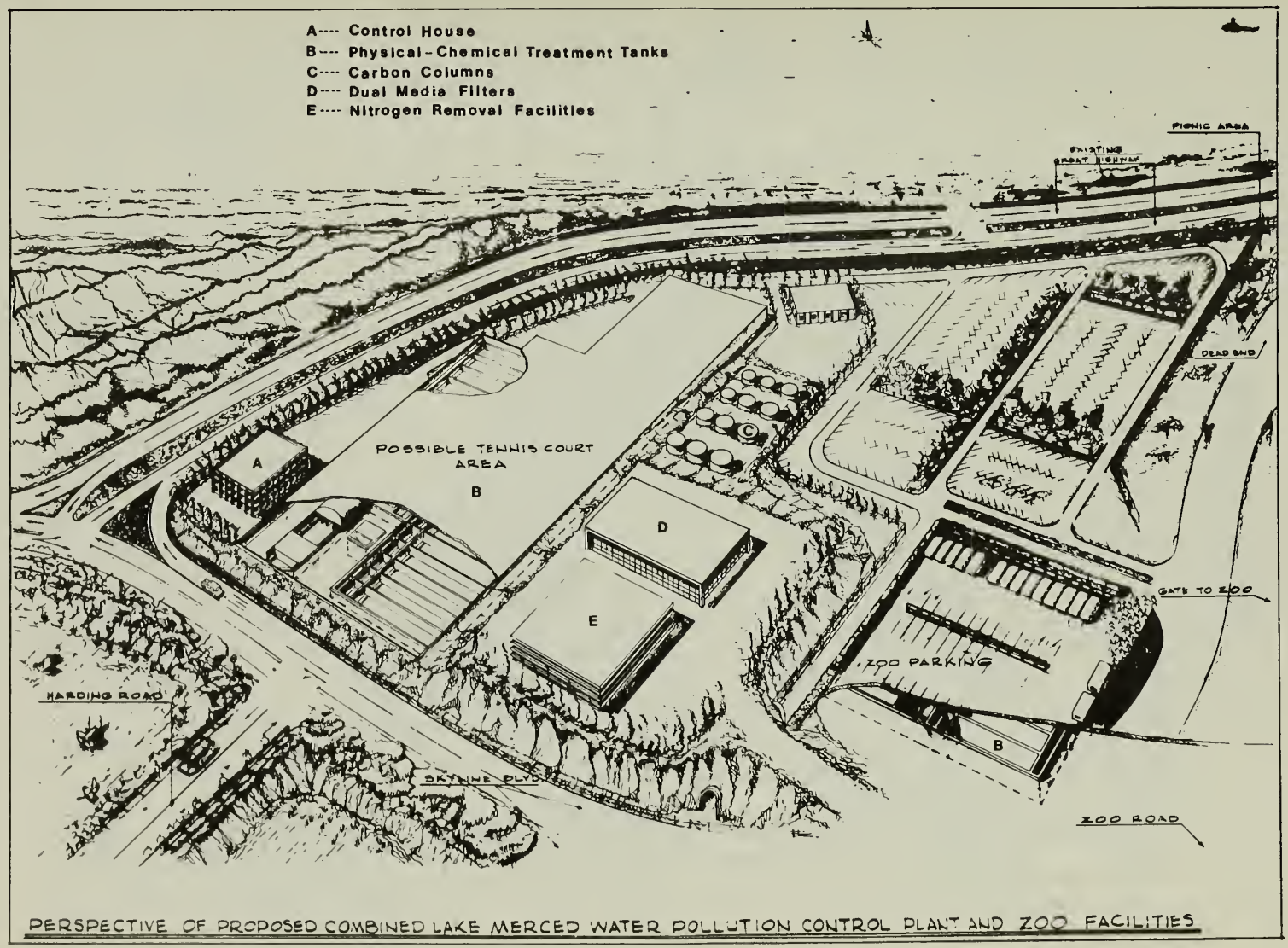
NOTE

1. PLANT AIR ABOVE AREAS WHERE WATER SURFACE IS BROKEN IS TO BE PLACED UNDER NEGATIVE PRESSURE AND EXHAUSTED THROUGH RECALCINATION FURNACES.

PLATE VI-20



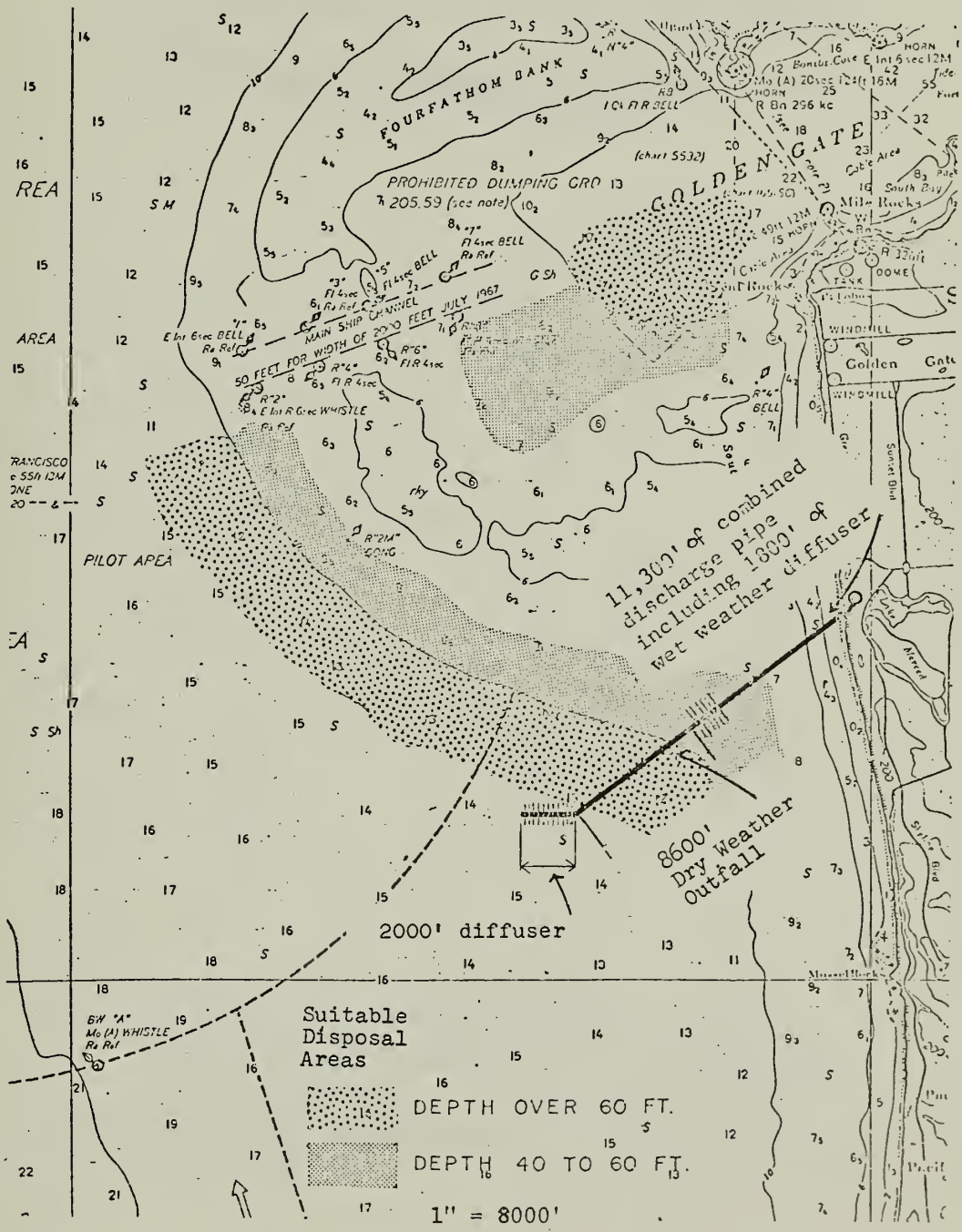
PROPOSED LAKE MERCED WATER POLLUTION CONTROL PLANT SITE
(PROPOSED ZOO PARKING LOT AND EXISTING FEDERAL AND STATE PROPERTIES)



PERSPECTIVE OF PROPOSED COMBINED LAKE MERCED WATER POLLUTION CONTROL PLANT AND ZOO FACILITIES

PLATE VI-23

PROPOSED OUTFALL LOCATION


FOURFATHOM BANK
PROHIBITED DUMPING GRD
GOLDEN GATE
MAIN SHIP CHANNEL
50 FEET FOR WIDTH OF 200 FEET JULY 1967
PILOT AREA
11,300' of combined discharge pipe including 1300' of wet weather diffuser
8600' Dry Weather Outfall
2000' diffuser
Suitable Disposal Areas
DEPTH OVER 60 FT.
DEPTH 40 TO 60 FT.
1" = 8000'

NET FUNDS REQUIRED (1974 MILLION DOLLARS) FOR TOTAL INADEQUATE SEWERS, DRY AND WET WEATHER PROGRAMS

(Assumes $100 Million Needed for Inadequate Sewers and $80 Million Presently Available) (1)

	ALTERNATE			
	A	B	C	D
Scheme I (2) Most Economical Method				
First Level (3)	$ 395	$ 458	$ 584	$ 727
Second Level	436	499	625	768
Third Level	483	546	672	815
Scheme II - R-S & SE to Ocean				
First Level	426	489	615	758
Second Level	478	541	667	810
Third Level	525	588	714	857
Scheme III - R-S, SE & NP to Ocean				
First Level	433	496	622	765
Second Level	485	548	674	817
Third Level	532	595	721	864

(1) $71 Million available in 1971 escalated to 1974 dollars for consistency to Master Plan Report.

(2) "Most Economical" means - optimized staging of facilities to meet wet weather requirements with least duplication of dry weather costs.

(3) Levels of treatment refer to dry weather periods only. Maximum treatment for wet weather is assumed to be low dose chemical treatment.

EFFECT TO TOTAL COST OF IMMEDIATE
COMPLIANCE WITH EPA 85% REMOVAL REGULATION

This table presents the costs of bringing the existing Richmond-Sunset, Southeast and North Point treatment plants to the First Level of treatment and the unrecoverable costs that would result in replacing these plants with a new plant at Lake Merced with an Ocean outfall.

	OCEAN DISPOSAL COSTS			
	Richmond-Sunset and Southeast WPCP's		Richmond-Sunset, Southeast and North Point WPCP's	
	First Level (Millions of $)	Second Level (Millions of $)	First Level (Millions of $)	Second Level (Millions of $)
I. TREATMENT PLANTS				
A. NORTH POINT				
a. Treatment Plant Improvements	$ 11.3	$ 15.8	$ 11.3	$ 15.8
b. Solids Handling at SEWPCP	8.5	16.5	8.5	16.5
Sub-total	19.8	32.3	19.8	32.3
B. SOUTHEAST				
a. Treatment Plant Improvements	7.1	8.0	7.1	8.0
b. Solids Handling	6.1	11.1	6.1	11.1
Sub-total	13.2	19.1	13.2	19.1
C. RICHMOND-SUNSET				
a. Treatment Plant Improvements	5.6	6.6	5.6	6.6
b. Solids Handling	2.2	7.0	2.2	7.0
Sub-total	7.8	13.6	7.8	13.6
SUB-TOTAL	40.8	65.0	40.8	65.0
II. PUMP STATIONS AND FORCE MAINS TO OCEAN	8.6	8.6	24.5	24.5
III. OUTFALL (NORTH POINT)	7.5	7.5		
TOTAL	$56.9	$81.1	$63.3	$87.5
Recoverable portion of dollar expenditure with development of the Lake Merced WPCP as a replacement plant				
a. Solids Handling at SEWPCP	$14.6	$27.6	$14.6	$27.6
b. Outfall	7.5	7.5	-	-
c. Pumps and Force Mains (See Note 1)	4.3	4.3	11.2	11.2
Sub-total	26.4	39.4	25.8	38.8
Unrecoverable portion of dollar expenditure	$30.5	$41.7	$37.6	$48.7

Note 1: A recoverable portion of $6.9 million and $4.3 million was allocated for the North Point and Southeast pump stations and force mains, respectively. It is believed that this portion of the force mains and pump stations could be utilized to connect to a proposed crosstown tunnel.

PLATE VI-13

In developing the estimates of the net funds required for the total program as shown on Plate VI-14 some simplifying conditions were assumed. These were:

1) The costs used for treatment facilities under Scheme I reflect the cost of combining all liquid waste treatment in a single plant with ocean disposal (Lake Merced) while retaining solids treatment facilities at the Southeast plant.

2) The costs of effecting immediate improvements at each of the existing plants which would be duplicated upon completion of the complete plan as noted on Plate VI-13, page XII-28, were added to the costs under Scheme I to develop the costs of treatment under Schemes II and III.

3) The remaining costs for all other facilities necessary for the total Master Plan were added to the treatment costs to develop the estimated net funds required for the total Master Plan programs.

While the costs shown do not exactly reflect the cost of other combinations of treatment facilities, the differences are within the accuracy of the total estimates. These estimates are sufficient to define the range of costs for policy development and selection of a conceptual plan. Cost differences

between schemes on Plate VI-14 must be considered on that basis.

Each scheme can be more completely described as follows:

Scheme I, the Lake Merced only treatment scheme, is included only because it is the most economical solution. It is not recommended as it requires that all presently planned treatment plant improvements with the exception of low cost interim facilities be deleted from the present program. This scheme proposes to intercept the flow now tributary to the three treatment plants and to divert that flow to the Lake Merced Plant at such time as the Master Plan staging schedule enables it to do so. This would substantially delay the projected improvements to the receiving waters during dry weather. This course of action with its associated delay of immediate effluent quality improvements, would require the approval of the Regional Board and EPA.

Scheme II assumes that to meet the Regional Board requirements and to maintain eligibility for Federal grants, the City would immediately transport the effluent from the Southeast treatment plant to the Lake Merced site, where, with the effluent from the Richmond-Sunset plant, it would be disposed of through the deep water outfall discussed earlier in this report.

Scheme II further assumes that the City will receive an EPA waiver to discharge the North Point effluent through a deepwater outfall near Alcatraz.

Scheme III assumes that the City will not obtain the waiver for the North Point Plant as set forth in Scheme II, and therefore must transport the North Point effluent to the Lake Merced site where, combined with the Richmond-Sunset effluent and Southeast effluent, it would be disposed of through a deepwater outfall.

Both Schemes II and III would afford continuous improvement in the quality of the effluent from all three plants. In addition, both schemes could be adapted in the future to the Wet Weather Master Plan when the necessary transport facilities were constructed under their appropriate staging. However, as previously noted and shown on Plate VI-13, on page XII-28, there would be a duplication of facilities and funds expended for transporting the effluent in advance of the Wet Weather facilities completion. These costs for Scheme II and Scheme III, assuming that second level of treatment will be required, are approximately $42 and $49 million respectively. In a sense, these facility costs must be considered to be amortized over

the time period used and are necessary to achieve continued compliance. Depending upon the resolution of the unknown factors and the selection and scheduling of the program, the expenditure of funds at this time for immediate improvement to the receiving waters may not result in any increased annual cost of the program even though total capital costs are higher. Development of these annual costs and programming must follow the adoption of the Master Plan and the resolution of the previously mentioned factors.

SECTION XII-B

Achieving Master Plan Criteria & Conditions

Referring to Section VII, the proposed Master Plan achieves the objectives set forth in the "Master Plan Criteria & Conditions."

1) Assurance Against Adverse Effect for Waste Disposal - The proposed location of the Lake Merced outfall will result in a net seaward dispersion, a minimum dilution of 100-1 and a submerged field during periods of dry weather. The bottom dwelling marine animals will be protected by providing for a surface field during periods of wet weather and by maintaining a dilution factor of safety of ten based upon the oceanographic and ecological criteria.

2) Building Block Type of Facility - The proposed Master Plan provides four alternates that would allow an overflow to occur from a maximum of 8 times per year to a minimum of once in 5 years. The plan enables a continuous movement towards reducing the frequency of overflow, but if this option is done on a building block staging, the total costs would be greater than building a facility for a particular alternate originally. The Master Plan also provides that the level of treatment for wet weather would

be equivalent to "first level treatment" (chemically treated primary effluent) and would have the capability of producing a first level, second level (intermediate treatment) or third level (high quality effluent, reclaimed waste water) for dry weather flow.

3) Not Adversely Affecting Development of City -The major storage facilities are underground either in tunnel or under City streets or on city property. Relatively little property is required for implementing the Master Plan. The retention basins at Islais Creek, China Basin and Yosemite (South Basin) would provide usable vista points for the public using the waterfront area. Multi-use facilities are incorporated where possible and public property use for single purpose facilities is minimized.

4) Financing Plan - The Master Plan is sub-divided into 16 stages with the priority on protection of the City's beaches and future recreational sites. The financing plan is discussed in detail in Section XIII.

5) Cost-Benefit Relationship for Wet Weather Control - The Master Plan includes on Plate VI-15, page XII-2, a tabulation of costs versus accomplishment based on the assumption that all wet weather flow would be treated to an equivalent of chemically treated primary effluent. Staging is developed to provide the most benefit for the costs required. This includes:

a) Immediate upgrading of effluent - The Master Plan provides the capability of continuing with the improvement of the three treatment plants, for the transport of effluent from any or all of the existing three treatment plants to the ocean disposal site.

b) Reduction in flooding - The implementation of the Master Plan would independently reduce the inadequate sewers enlargement cost, estimated at $150 million to a cost estimated at $100 million. The inland retention basins for the tunnel storage facilities would result in an immediate reduction of flooding of the low land areas.

c) Reduction of emissions caused by overflow -The Master Plan for all alternate schemes would reduce the suspended solids, grease and phosphates approximately 70%, the COD and floatables approximately 35%, and nitrogen approximately 7%.

d) Industrial waste program - The City has initiated such a program and it is expected that in a few years the effect of such a program will make a substantial improvement to the toxic effect of industrial waste. This will be particularly true of chronic or long term toxicity.

e) Consolidation of treatment plants - As set forth above, the Master Plan has the capability of phasing out any one or all of the existing plants.

f) Prohibition of Bay discharge - The completion of all of the stage constructions set forth in this section would provide the capability of prohibiting any Bay discharge of effluent or combined overflow into San Francisco Bay up to the design alternate adopted.

g) Solids handling problems - Upgrading the degree of treatment during dry weather and the solids produced during wet weather will produce sludge that is many times than being handled at present.

The Master Plan recognizes the solids handling problem and that the only conceivable location for processing this large volume is at the present Southeast Treatment Plant. The Southeast Sewage Treatment Plant has available land, dryer building space, and even an incinerator stack in the event that removal of filter cake to a sanitary land fill proves to be impractical. The Southeast Plant also has a rail spur in the event that a local or regional rail haul of solid waste is ever implemented. The plant is in an industrial area and therefore compatible with such an operation. The primary sludge from the proposed Lake Merced Treatment Plant would be pumped to the Southeast Plant for processing, while any lime sludge will be handled at the Lake Merced site.

6) Sub-Regional Pollution Control - The Master Plan fits the concept of being integrated with a Bay Area regional plan. The plan has the capability to accomodate flows from other

cities such as Pacifica or North San Mateo County Sanitation District without making a material difference in the facility planning.

7) Underground Storm Storage - The Master Plan utilizes tunnels for storage and transport only in those locations and at those elevations which will allow gravity dewatering. All plans involving low level tunnels requiring pumping were discarded as being undesirable from a maintenance stand point.

8) Central Control System - The Master Plan contemplates a Central Computer System so that during periods of wet weather heavy materials can be delivered to the treatment plant while diluted materials would be effectively stored until the treatment plant could accomodate the dewatering of the storage facility. The system would provide means of controlling an area to reduce flooding and to provide the necessary data for maintenance and operation.

SECTION XIII

FINANCING

Historical

Prior to 1971, San Francisco sewerage facilities were financed by the following means:

(a) Side sewers - by individual property owners.

(b) New public sewers - by single assessment of benefited property owners of the cost equivalent to a 12-inch diameter pipe in place for the portion of the cost of a sewer larger than 12-inch in diameter by general obligation bonds.

(c) Catch basins and culverts - gas tax funds.

(d) Treatment plants, intercepting sewers, diversion structures, pumping stations, sewer replacement and enlargement, by general obligation bond issues.

(e) Maintenance and operation of all sewerage facilities and the enforcement of an Industrial Waste Ordinance - by annual budget.

In 1971 a new Industrial Waste Ordinance was adopted which established a specific fund into which all revenues collected from the enforcement of the 1971 Industrial Waste Ordinance are to be deposited. It is expected that after the industrial waste program is under full operation, the revenue collected will be approximately $500,000 annually. This amount approximates the cost of administering this program and the additional cost of treatment caused by the industrial waste discharge.

In 1971 the City also adopted a sewer service charge, based on water consumption, to finance the maintenance and operation expenses of all sewerage facilities and to pay for the interest and redemption of sewerage and water pollution bond issues authorized through the year 1970. It is expected that the sewer service charge will generate $13 million annually.

Regional Board Requirement

The Regional Board's resolution, requiring the submittal of the City-wide Sewerage Master Plan, requires that a program for financing the implementation of the Master Plan and setting of dates necessary for sewer bond election be included. This cannot be done because of the decisions that must be made on the

below listed factors. However, the City will recommend to the Regional Board an overflow occurrence and a percent of the total City's uncommitted resources that should be allocated for waste water management. The bond issue schedule can only be established when the remaining variables are determined.

(a) Frequency of overflow occurrence (Alternates A to D).

(b) Effluent disposal site for North Point plant (Schemes I, II and III.

(c) Level of dry weather treatment (Levels 1, 2, or 3).

(d) Years for completion of all facilities.

(e) Grant percent (0% to 80%).

(f) The percent (and amount) of the City's resources that should be allocated for waste water management.

The future fund requirements, in 1974 dollars, for each of the 36 possible program combinations for "factors" A, B, and C are tabulated on Plate VI-15, page XII-2 and Plate VI-14, page XII-27. This future fund is the net summation of the dry weather, wet weather and inadequate sewers costs, less available funds for water pollution and sewers from all bond issues through 1970. As will be noted, the costs varies from $395

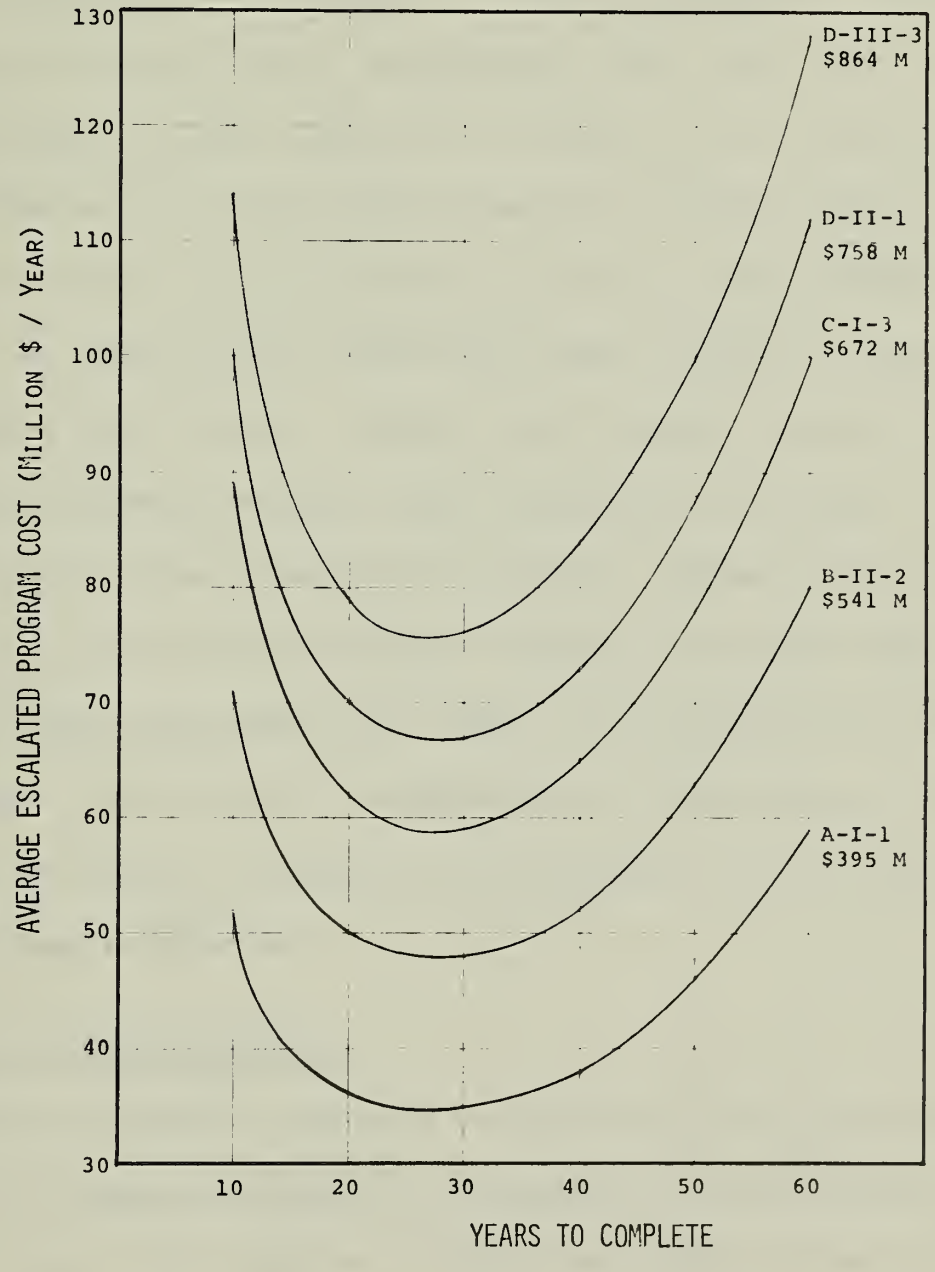
million to $864 million.

The total net cost for each of the 36 possible programs was escalated at the rate of 6% per year for a 10, 20, 30, 40, 50 and 60 year completion period. Plate IX-4, page XIII-5 shows a correlation between "Years to Complete" and "Average Escalated Program Cost" (million dollars per year) for 5 selected programs. This plate illustrates that a program completion period of approximately 25 years will require the least cost per year. The "Escalated Total Costs" and "Annual Costs" for each program are tabulated on Plate IX-3, page XIII-7. The total cost including escalation varies from $521 million for the least expensive program (10 years) to $7.68 billion (60 years) for the most expensive.

Grants

The amount of federal funds and the eligibility requirements for grants has changed almost continuously. Until the early 1960's when the City did not qualify for federal grants for sewage treatment works because priority points given for "financial-need" placed San Francisco projects too low on the eligibility list. The method of establishing priority was subsequently revised, and the City has received the maximum grant (33%) on

ANNUAL PROGRAM COST vs YEARS TO COMPLETE
(VARIOUS PROGRAMS)



several of its treatment projects. With the passage of the 1970 $250 million California State Clean Water bond issue, the first state grants were made available for treatment facilities. This resulted in the increase in federal allocation from 33% to 55% provided the State contributes 25%. This would require the discharger to bear 20% of the expense of the total project cost. However, the State Water Resources Control Board, in administering the federal funding program, is not obliged to certify the total federal 55% which would result in less than the 80% maximum total grant. Further, wet weather projects are considered a lower priority than dry weather projects, and are not at the present time scheduled for grants, either State or Federal.

There is also limited federal funding available under the Housing Urban Development Act (HUD) for construction of sewer facilities, but the City's eligibility is dependent on the acceptance by HUD for treatment of wet weather flow in lieu of sewer system separation.

Percent of City Resources

The most feasible approach to determine what percentage of the City's resources should be allocated for waste water management is that it be based on a fixed percentage of the City

ESCALATED COSTS FOR VARYING COMPLETION PERIODS

PROGRAM	1974 $	ESCALATED DOLLARS (MILLIONS)											
		10-YR (FACTOR 1.32)		20-YR (FACTOR 1.64)		30-YR (FACTOR 2.64)		40-YR (FACTOR 3.87)		50-YR (FACTOR 5.81)		60-YR (FACTOR 8.59)	
		Total	Annual	Total	Annual	Total	Annual	Total	Annual	Total	Annual	Total	Annual
A-I-1	395.	521.	52.	727.	36.	1043.	35.	1529.	38.	2295.	46.	3512.	59.
A-II-1	426.	562.	56.	784.	39.	1125.	37.	1649.	41.	2475.	50.	3787.	63.
A-III-1	433.	572.	57.	797.	40.	1143.	38.	1676.	42.	2516.	50.	3849.	64.
A-I-2	436.	576.	58.	802.	40.	1151.	38.	1687.	42.	2533.	51.	3876.	65.
B-I-1	458.	605.	60.	843.	42.	1209.	40.	1772.	44.	2661.	53.	4072.	68.
A-II-2	478.	631.	63.	880.	44.	1262.	42.	1850.	46.	2777.	56.	4249.	71.
A-I-3	483.	638.	64.	889.	44.	1275.	43.	1869.	47.	2806.	56.	4294.	72.
A-III-2	485.	640.	64.	892.	45.	1280.	43.	1877.	47.	2818.	56.	4312.	72.
B-II-1	489.	645.	65.	900.	45.	1291.	43.	1892.	47.	2841.	57.	4347.	72.
B-III-1	496.	655.	65.	913.	46.	1309.	44.	1920.	48.	2882.	58.	4409.	73.
B-I-2	499.	659.	66.	918.	46.	1317.	44.	1931.	48.	2899.	58.	4436.	74.
A-II-3	525.	693.	69.	966.	48.	1386.	46.	2032.	51.	3050.	61.	4667.	78.
A-III-3	532.	702.	70.	979.	49.	1404.	47.	2059.	51.	3091.	62.	4729.	79.
B-II-2	541.	714.	71.	995.	50.	1428.	48.	2094.	52.	3143.	63.	4809.	80.
B-I-3	546.	721.	72.	1005.	50.	1441.	48.	2113.	53.	3172.	63.	4854.	81.
B-III-2	548.	723.	72.	1008.	50.	1447.	48.	2121.	53.	3184.	64.	4872.	81.
C-I-1	584.	771.	77.	1075.	54.	1542.	51.	2260.	57.	3393.	68.	5192.	87.
B-II-3	588.	776.	78.	1082.	54.	1552.	52.	2276.	57.	3416.	68.	5227.	87.
B-III-3	595.	785.	79.	1095.	55.	1571.	52.	2303.	58.	3457.	69.	5290.	88.
C-II-1	615.	812.	81.	1132.	57.	1624.	54.	2380.	60.	3573.	71.	5467.	91.
C-III-1	622.	821.	82.	1144.	57.	1642.	55.	2407.	60.	3614.	72.	5530.	92.
C-I-2	625.	825.	82.	1150.	57.	1650.	55.	2419.	60.	3631.	73.	5556.	93.
C-II-2	667.	880.	88.	1227.	61.	1761.	59.	2581.	65.	3875.	78.	5930.	99.
C-I-3	672.	887.	89.	1236.	62.	1774.	59.	2601.	65.	3904.	78.	5974.	100.
C-III-2	674.	890.	89.	1240.	62.	1779.	59.	2608.	65.	3916.	78.	5992.	100.
C-II-3	714.	942.	94.	1314.	66.	1885.	63.	2763.	69.	4148.	83.	6347.	106.
C-III-3	721.	952.	95.	1327.	66.	1903.	63.	2790.	70.	4189.	84.	6410.	107.
D-I-1	727.	960.	96.	1338.	67.	1919.	64.	2813.	70.	4224.	84.	6463.	108.
D-II-1	758.	1001.	100.	1395.	70.	2001.	67.	2933.	73.	4404.	88.	6739.	112.
D-III-1	765.	1010.	101.	1408.	70.	2020.	67.	2961.	74.	4445.	89.	6801.	113.
D-I-2	768.	1014.	101.	1413.	71.	2028.	68.	2972.	74.	4462.	89.	6828.	114.
D-II-2	810.	1069.	107.	1490.	75.	2138.	71.	3135.	78.	4706.	94.	7201.	120.
D-I-3	815.	1076.	108.	1500.	75.	2152.	72.	3154.	79.	4735.	95.	7245.	121.
D-III-2	817.	1078.	108.	1503.	75.	2157.	72.	3162.	79.	4747.	95.	7263.	121.
D-II-3	857.	1131.	113.	1577.	79.	2262.	75.	3317.	83.	4979.	100.	7619.	127.
D-III-3	864.	1140.	114.	1590.	79.	2281.	76.	3344.	84.	5020.	100.	7681.	128.

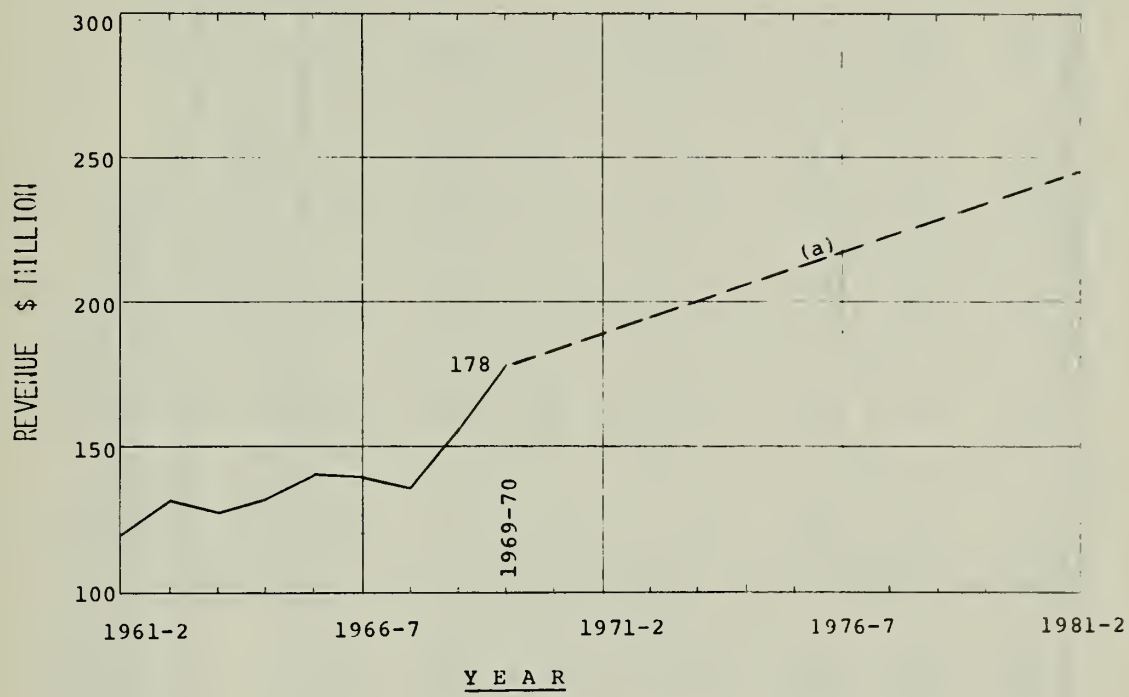
total uncommitted revenues. It was further assumed that the tax rate revenue for education, welfare and the Bay Area Rapid Transit, should also be excluded. This net amount is defined, for the purposes of the Master Plan, as the "Uncommitted City Resources".

As shown on Plate IX-6, page XIII-9, the Uncommitted City Resources from 1961-62 through 1969-70 rose from $119 million to $178 million at a rate of approximately $5.45 million per year. This rate was used for the determination of future revenue over the 60 years covered in the Master Plan.

A further assumption was made that the allocation for wastewater management would likely be between 3% to 9% of the Uncommitted City Resources. The upper limit was fixed at 15% for this Report. Plate IX-7, page XIII-10, tabulates the gross and net future funds that can be generated by a 3%, 5%, 7% and 9% allocation for the 10-year through 60-year programs. The gross funds shown on the chart indicate the total water pollution control resources, that is, a percent of city resources plus the sewer service charge.

The net future funds, or that amount available for water pollution programs, assumes that for the first 11 years, the

PROJECTIONS OF UNCOMMITTED CITY RESOURCES



Excludes Education, Welfare and B.A.R.T.D.

(a) Projected at the past rate of increase of $5.45 million per year.

YEAR	PROJECTED REVENUE ($M)
1983-84	$256
1993-94	311
2003-04	367
2013-14	422
2023-24	478
2033-34	534

REVENUE PRODUCED (MILLIONS OF DOLLARS)
FOR VARYING PERCENTAGES OF UNCOMMITTED CITY RESOURCES

% City Uncommitted Resources		YEAR OF PROGRAM					
		10	20	30	40	50	60
3	Gross Funds: Total:	$197	$410	$640	$886	$1149	$1429
	Ave. Annual:	19.7	20.5	21.3	22.1	23.0	23.8
	Net Available for New Projects Total:	68	214	384	570	774	993
	Ave. Annual:	6.8	10.7	12.8	14.2	15.5	16.6
5	Gross Funds Total:	242	511	808	1133	1486	1866
	Ave. Annual:	24.2	25.6	26.9	28.3	29.7	31.1
	Net Available for New Projects Total:	113	315	552	817	1110	1430
	Ave. Annual:	11.3	15.8	18.4	20.4	22.2	23.8
7	Gross Funds Total:	287	612	977	1378	1822	2303
	Ave. Annual:	28.7	30.6	32.6	34.5	36.4	38.4
	Net Available for New Projects Total:	158	416	721	1064	1446	1867
	Ave. Annual:	15.8	20.8	24.0	26.6	28.9	31.1
9	Gross Funds Total:	332	714	1145	1627	2158	2740
	Ave. Annual:	33.2	35.7	38.2	40.7	43.2	45.7
	Net Available for New Projects Total:	203	518	889	1311	1782	2304
	Ave. Annual:	20.3	25.9	29.6	32.8	35.6	38.4

PLATE IX-7

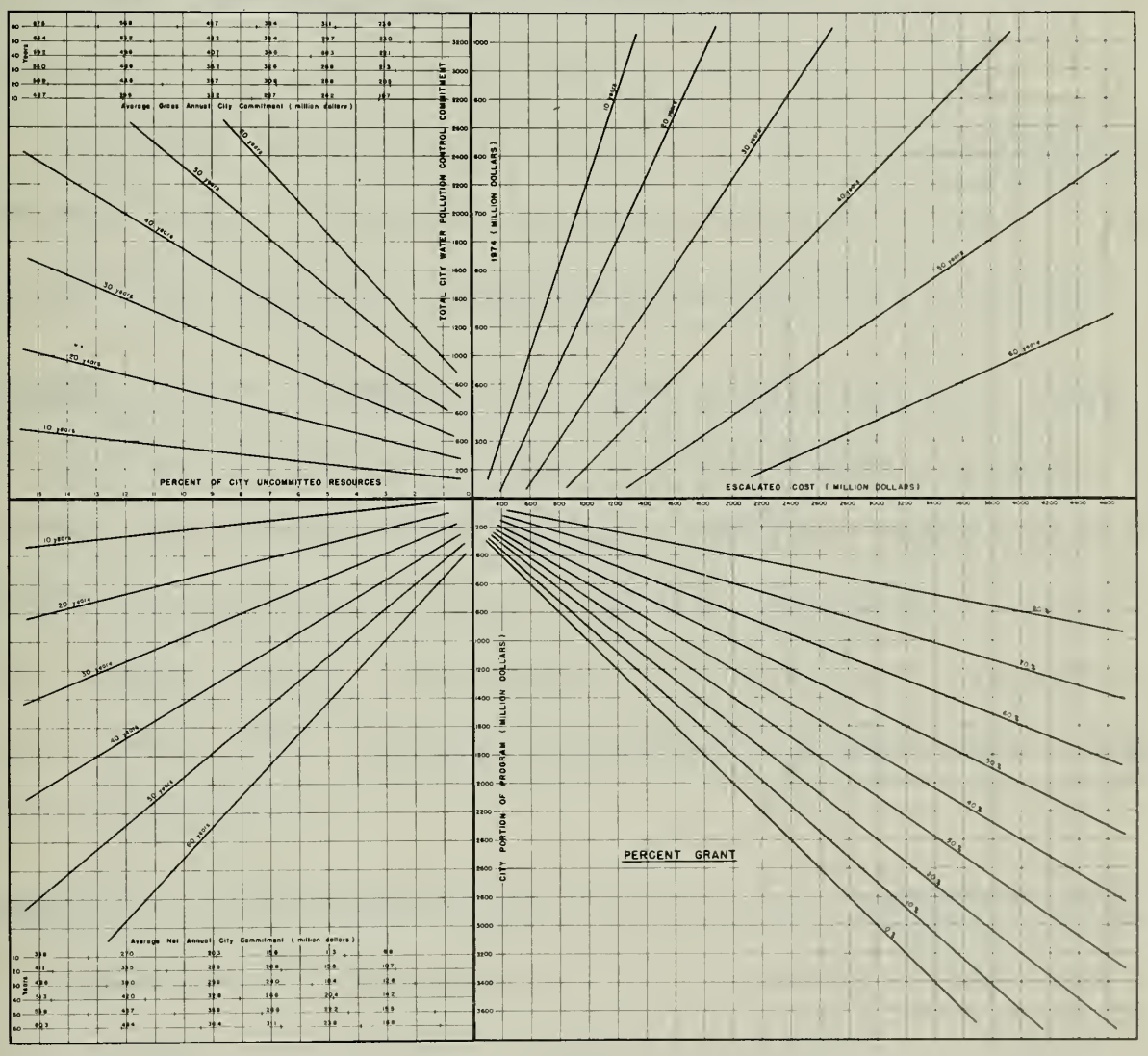
sewer service charge will finance both the maintenance and operation costs and sewerage bond commitment authorized through 1970. After 11 years, only the maintenance and operation costs of $6 million per year would be deducted and the remaining sewer service charge funds of $7 million would be available for new projects.

It can be noted from Plate IX-7, page XIII-10, that assuming a 30-year program and a 5% allocation, the gross revenue generated annually would be $26.9 million of which $ 13 million would be from the sewer service revenue.

Correlation of Variables

The six variables listed on page XIII-3 are correlated in a graph shown on Plate IX-15, page XIII-14. This plan enables, for any of the 36 programs given years for completion, the determination of amount of grant, or percent of uncommitted City resources that would be required. To illustrate, if it is assumed that: (a) Program B-II-2 which is a selected occurrence of overflow would be four times per year - Southeast effluent transported to the ocean - North Point would obtain a waiver and continue to operate - that all plants would upgrade the effluent to the Level 2 (intermediate level); (b) that the years for completion was

GRAPH OF PROGRAM - PERCENT UNCOMMITTED RESOURCES - GRANTS - YEARS FOR COMPLETION


Average Gross Annual City Commitment (million dollars)
PERCENT OF CITY UNCOMMITTED RESOURCES
TOTAL CITY WATER POLLUTION CONTROL COMMITMENT 1974 (MILLION DOLLARS)
ESCALATED COST (MILLION DOLLARS)
Average Net Annual City Commitment (million dollars)
CITY PORTION OF PROGRAM (MILLION DOLLARS)
PERCENT GRANT

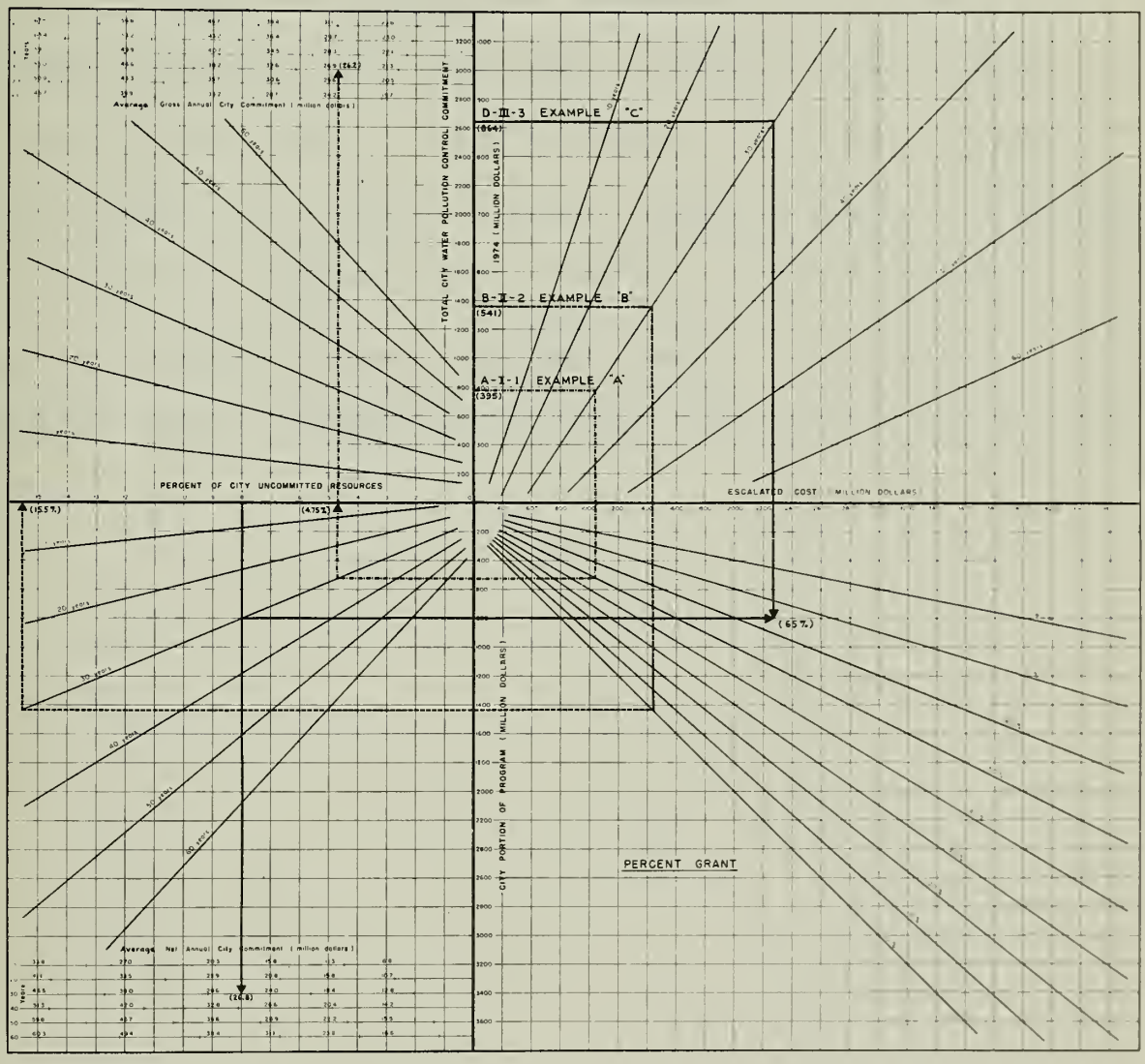
selected to be 20 years; (c) the grant would be 50%; then the total percent of the City's uncommitted resources for those assumptions would be 8.7% which, when added to the sewer service charge, would result in a total City commitment of $35 million per year. Additional examples are described on pages XIII-13 and XIII-15 and are shown on Plate IX-15, page XIII-14.

The graph on Plate IX-14 can be read for any combination of program, period of completion, percent grant and percent of City Uncommitted Resources. Examples of the use are as follows:

Example A: Given Program A-I-1 ($395 million 1974), 30 years, 50% grants. Determine % of City Uncommitted Resources and average gross annual City commitment. Enter at ($395 million). Proceed horizontally to right to 30 year, then down to 50 percent grants, then to left quadrant to 30 year, and vertically to axis. Read 4.75%. Continue vertically to 30 year scale. Read $26.2 million/year.

Example B: Given Program B-II-2 ($541 million 1974), 30 years, 0 percent grants. Determine % of City Uncommitted Resources. Enter program $541 million. Proceed horizontally to right to 30 year, then down to zero (0) percent grants. Extend horizontally to left to 30 year, then vertically to axis at 15.5 percent.

EXAMPLES OF THE USE OF PLATE IX-14



Value is outside range of 3 to 9 percent indicating Program B-II-2 is not practical with zero percent grants.

Example C: Given Program D-III-3 ($864 million 1974), 30 year, 8% City Uncommitted Resources. Determine percent grant and average Net Annual City Commitment. Enter at $864 million. Proceed horizontally to right to 30 year, then down through lower quadrant for percent grants. Re-enter graph at 8 percent City Commitment, proceed down to 30 year, then horizontally to right to intersect line in percent grants. Interpolate at 65%. Re-enter at 8%, proceed down and read $26.8 million on 30 year scale.

287-5